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CIVIL ENGINEERING

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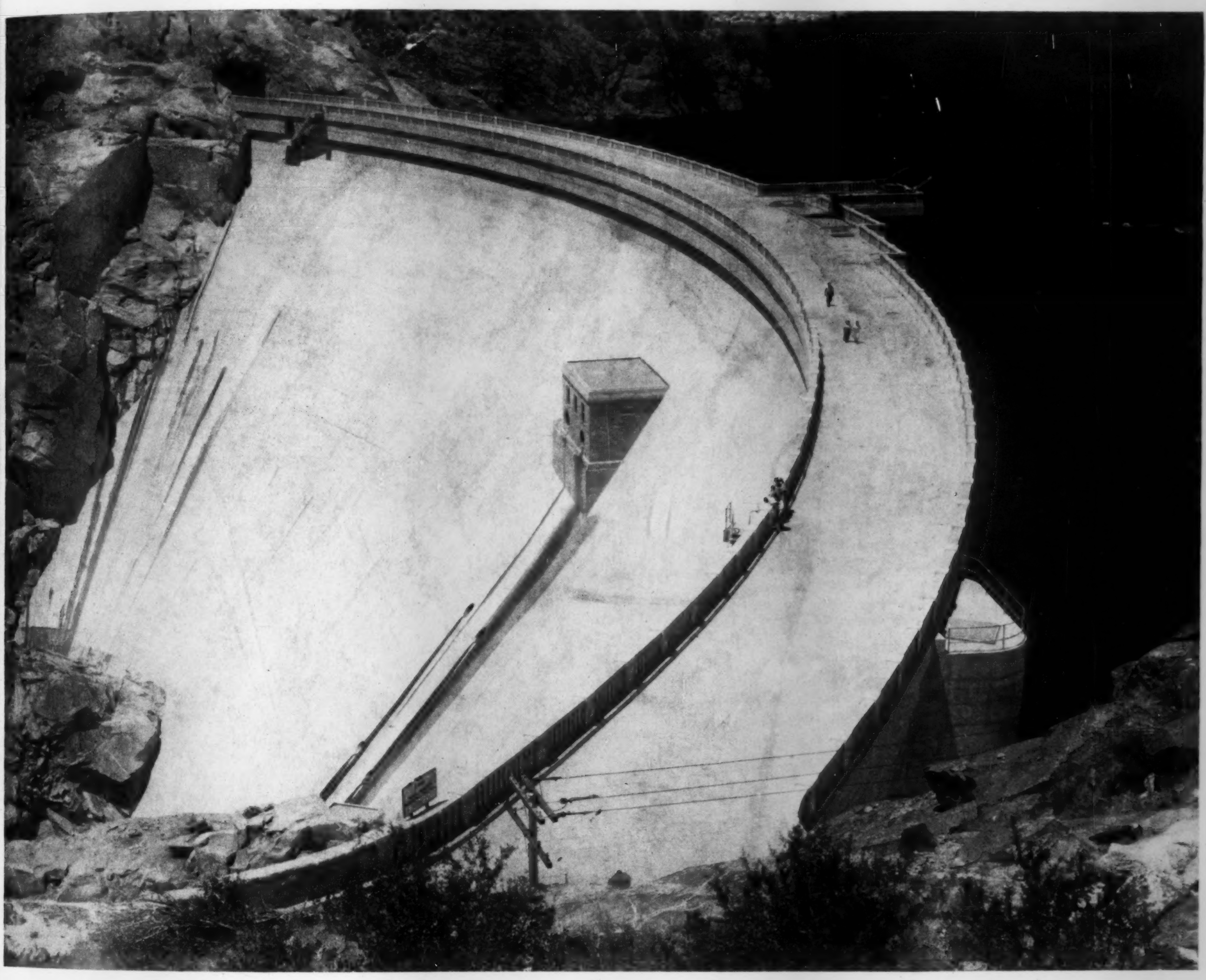

O'Shaughnessy Dam—Main Storage Unit in San Francisco's Water System—as Recently Raised and Thickened
Many Hydraulic Problems Will Be Discussed at the Annual Convention at San Francisco—See Program Inside

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JULY 1939

Factual Survey of Civil Engineer's Income to Be Made—See Page 439

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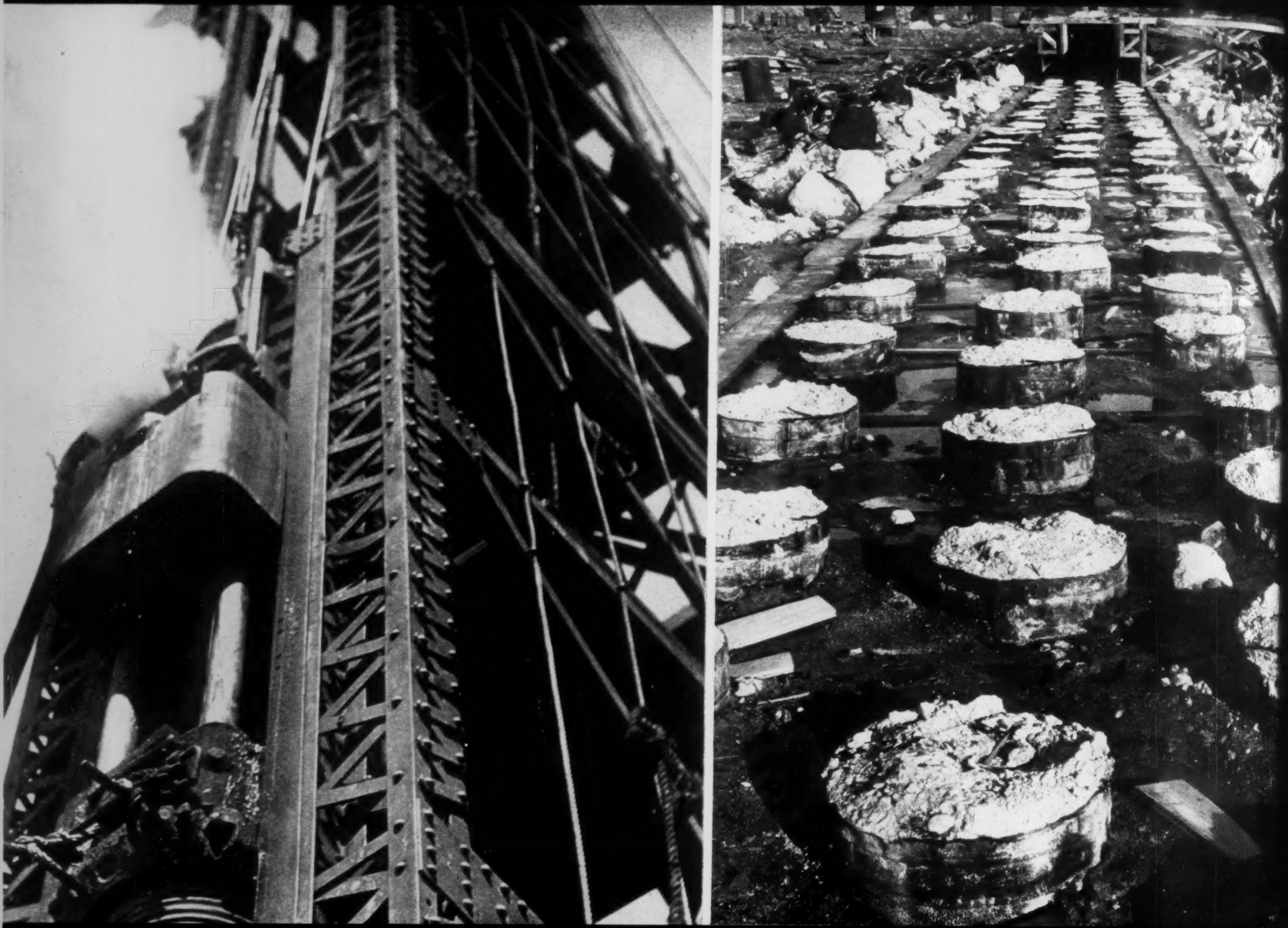

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Among Our Writers

C. Frank Allen was graduated 67 years ago from the Massachusetts Institute of Technology, and most of his professional life has centered about that school, where he taught for almost 30 years. He has been president of the Society for the Promotion of Engineering Education and the Boston Society of Civil Engineers.

Kenneth Markwell left private practice in Memphis in 1933 to go with the PWA. He was state engineer for Tennessee 1934 to 1937, with about $50,000,000 in all types of projects under him. Later he was chief project engineer with supervision of 22 power projects in the Tennessee Valley area. His present assignment dates from 1938.

Gerard H. Matthes started work 43 years ago as rodman on a survey of the Connecticut River, and has been concerned in some engineering way with rivers large and small ever since. His experience has included stream gaging, investigations for irrigation projects, power projects, and flood control and navigation work.

T. P. Pendleton has specialized in topographic mapping for thirty years, the greater part of which time has been devoted to mapping by photogrammetric methods. His experience includes service as chief, Section of Photo Mapping, Geological Survey; and chief engineer, Brock and Weymouth, Inc.

R. L. Bertin has been chief engineer of the White Construction Company since 1917. He has been active for 30 years in the development of concrete and reinforced concrete and has served on many committees of the American Concrete Institute and the American Society for Testing Materials.

Frank A. Marston (Worcester Polytechnic Institute, 1907) has been a partner of Metcalf and Eddy in consulting practice since 1920. Recent engagements include the sewage treatment plant and Rock Creek diversion sewers for the District of Columbia; also sewage disposal review and sanitary problems on the Delaware Aqueduct for the City of New York.

F. B. Butler has served with the Corps of Engineers, U.S.A., since 1918. Since 1936 he has been in charge of construction of Treasure Island and its approach roadways and water supply, and construction in connection with the modernization of the harbor defenses of San Francisco.

George H. Otto graduated from the University of Chicago in geology, 1931, and alternated advanced schooling with work on engineering geology of the Chicago region for the Illinois State Geological Survey until 1935. Since then he has been with the S. C. S.

Hunter Rouse received a traveling fellowship in hydraulics on graduating from M.I.T. in 1929, and spent $2^1/_2$ years studying laboratory technique in Europe. This was followed by 2 years at M.I.T. and $2^1/_2$ years at Columbia. Since 1936 he has been with the S. C. S. This fall he goes to the University of Iowa as professor of hydraulics.

Ralph W. Eaton, a graduate in electrical engineering of M.I.T., held positions with Westinghouse Electric and Manufacturing Co., the Connecticut Co., and the Shore Line Electric Railway Co., before becoming public service engineer of the City of Providence in 1918—a post he still holds. Later he was also made traffic engineer.

Dewey M. McCain (B.S., Mississippi State College, 1921; M.S., University of Tennessee, 1924) has been professor of civil engineering at M.S.C. since 1930. Previously he had been associated with an architect in building design, and had later served as district engineer for the Concrete Steel Company at Birmingham.

L. H. Berger has spent a lifetime in the manufacture of engineering and surveying instruments, with the firm established by his father in 1871. He became its president in 1922.

E. E. Howard in the past 38 years has had experience embracing practically every phase of bridge construction, and the work of his firm includes many large and notable structures. He has been chairman of the board of trustees of the University of Kansas City since that institution was started. Just this month the University of Nebraska granted him the honorary degree of doctor of engineering.

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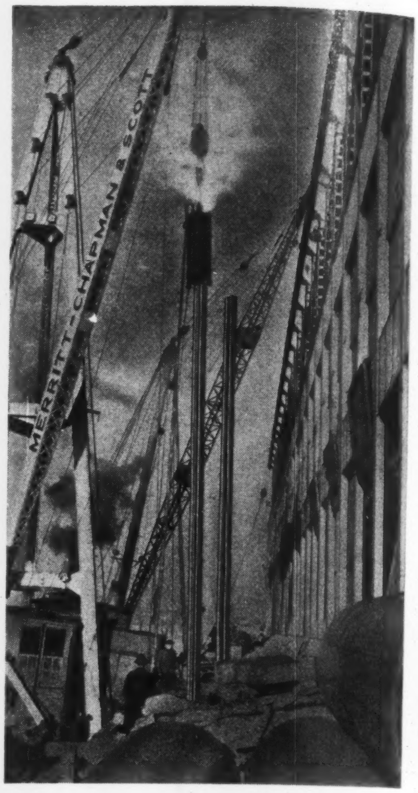
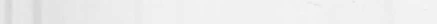
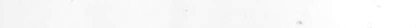


DEEP PENETRATION—HEAVY LOADING. Into the ocean floor under Boston's biggest pier goes 58,000 feet of U·S·S Steel Bearing Piles, in lengths up to 137′. In a 24-hour 121-ton load test an 85′ pile settled only 5/16″ and recovered to within 1/32″ of original elevation.

HORIZONTAL LOAD RESISTANCE. In addition to heavy vertical loading, 6 tons of lateral loading per pile must be safely carried by the foundations for Emsworth Dam on the Ohio River. Engineers chose U·S·S CBP Steel Bearing Piles because of their high resistance to combined stresses. They proved practical and easy to drive.



BIG TONNAGE—"ON-TIME" DELIVERIES. 8,121 U·S·S Steel Bearing Piles support the foundation of the Ford Motor Company's new press plant at River Rouge. Approximately 1600 tons of these sections, in single lengths up to 105 ft., were shipped weekly to ensure rapid progress and on-time completion of this important foundation job.



DOUBLE PURPOSE. Note the perfect alignment and simplicity of this trestle in Clay County, Florida. Here is an effective double-purpose design. U·S·S Steel Bearing Piles act both as bearing piles and trestle bent columns. To withstand flood-borne loads and impacts and lateral shocks, experience dictates the choice of U·S·S Steel Bearing Piles.

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UNITED STATES STEEL

Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

Seventy Years an Engineer

Notes from a Life Spent in Various Localities and Spheres

By C. Frank Allen

Honorary Member American Society of Civil Engineers
Professor Emeritus, Massachusetts Institute of Technology, Cambridge, Mass.

My experience during a long period of active life (due mainly to a favorable ancestry), has provided a perspective over the engineering field of which this Society forms a part. A few glimpses of what I found there may be of interest and value to others.

My earliest employment in surveying, during my first summer vacation from college, was in an engineer's office in Boston, when the "student system" was in vogue. This was in the nature of an apprenticeship, but not so named. The "student" received a dollar a day during the first year, a dollar and a half the second year, and two dollars the third year—that is, when he worked. But he had to pay $100 a year for "instruction." This system prevailed quite generally and had not been altogether abandoned as late as 1880. I started in at a dollar a day and paid two dollars a week for instruction. Working hard and long, I netted about twenty dollars for fully three months of work. In those days, seventy years ago, transits had not yet acquired shifting heads; the surveyor had to set up over a point entirely by "jollying" the tripod legs.

Value vs Remuneration.~Following graduation, I acquired a desirable variety of positions, quite early electing to accept a decrease in salary in order to secure valuable experience. I still entertain the theory that unless he is unduly burdened with debt, an engineering graduate should look for experience rather than either salary or permanence during the first three to five years. Possibly along the same line was the advice given by a chief engineer to his assistant receiving $125 a month, who was offered $250 a month with a large municipality; the chief merely said, "It is more important to be worth $250 a month than to receive it." The assistant stayed, and later became chief engineer of the New York subways.

At the time of my graduation from the Massachusetts Institute of Technology, there existed among engineers in practice, as well as among others, a certain amount of prejudice against college trained men. In fact, the Society exercised discrimination of a similar sort; service as a professor of engineering was for many years not accepted as practice of engineering. The head of one of our best-known schools of engineering, a West Point graduate at that, was classified as an Affiliate, and retained that grade until his recent death. Whether or not the action of the Society was at that time unfair, no fault can now be found in its attitude toward the "Profession of Engineering Teaching" as it was defined by an eminent professor, later a President and an Honorary Member of the Society.

Honor the Men of Old.~There is no need to ascribe any such prejudice to jealousy. For the earlier engineers I entertain great respect. Probably few of them were accomplished mathematicians. However, they must have had for those times an adequate acquaintance with hydraulics and the fundamentals of mechanics, including strength of materials; and with these as a background and with precedent and experience to rely upon, they had developed a sound engineering sense. This, after all, is the final basis for action. If they felt some distrust of others deficient in experience, it was hardly a fault. There is even yet a chance that a college bred engineer may, in his earlier years, err in pursuing a mathematical solution in cases where prompt accomplishment is more important than the best method or the best result. Moreover, the earlier engineers had more time for careful thought and self-imposed education than do engineers in the strenuous times of today.

Do not think that I minimize the value of engineering education; far from it. The "graduate of the axe handle" who rises to the top—as he may, but of late less often does—must have distinctly superior qualities. Nowadays he must acquire in his own way and with difficulty much that the college trained man has been taught. He may, with the limited time at his disposal, absorb the important principles, while the "average" college man tends somewhat to be unduly attracted by details. It is true, further, that many engineering accomplishments did not require mathematical analysis. A conspicuous example was the Mississippi jetties, where the solution of the problem turned on the use of willow mattresses.

With regard to engineering judgment, there is the story of the chief engineer of a New England railroad who quoted two proverbs of equal merit as applied to railroad work. One was, "Never put off till tomorrow what you can do today," and the other, "Never do today what you can put off till tomorrow." It kept him busy deciding which to apply in a given case.

Growing in Esteem.∼Even as late as my entry into engineering practice, I believe it was true that, mainly, people employed engineers because they did not know how to do without them; today, quite largely, they employ engineers because they cannot afford to do without them. In the earlier period, the money paid engineers appeared to be a necessary, if unwelcome, part of the expense of the project. Today, it is largely realized that the skilled engineer is a money saver, effective economically, both in construction and in operation and maintenance, and this attitude operates to the advantage of the profession in many ways.

In this connection it is of interest to mention that even in the early eighties the Santa Fe Railroad, with which I was then connected, was comparing alternate routes with reference to distance, curvature, rise and fall, and gradients, as well as first cost, following the methods of Wellington's *Economic Theory of Railway Location*, then in an early edition. Later, Harriman, a perfecter rather than a builder as was Hill, among other changes on the Union Pacific virtually or actually abandoned $9,000,000 of railroad for a new line more economical in operation. It is worthy of note that even in the present depression, Harriman's Union Pacific is still paying dividends.

Advantages in Drafting Ability.∼There were depressions in those days, too. The exceptionally severe one of the seventies so delayed nearly all engineering enterprises that I packed my valise and started west, with California as my ultimate goal if all else failed, for I was reasonably assured of employment there.

When I had reached Pueblo, Colo., there were assurances of early employment on the Santa Fe Railroad. My first opportunity was as a draftsman, nominally a temporary job. For this work I was well fitted and became a permanent employee. Some time later I was put in charge of the drafting office.

Many times during my years of teaching, I have heard it confidently asserted that being a good draftsman is a liability and not an asset. In my experience with students, this is entirely a fallacy. Usually my good student draftsmen have been successful afterwards. It is no handicap to have acquired the habit of doing things well. A college president once told an assistant, who was resigning to accept a commercial position, "The important thing is to do your job better than your employer expects you to." My good students, as a rule, were good in all departments.

What Makes Success?∼My formula, cherished for many years, is that the successful man is the one who knows how to take advantage of his opportunities, rather than the one, otherwise of superior ability, who lacks this quality. It appears also to be true that it is wise not to tie to a man who is habitually unlucky.

In my case, at Pueblo, a draftsman's job was an asset—for I had traveled 2,000 miles from home, second class, and with not too much cash in my pocket. It was my start in railroad engineering—an opportunity which finally led to a professorship at my alma mater. From this, in turn, other activities radiated, bringing whatever success I have attained.

While waiting, near Pueblo, for my job with the Santa Fe, it was my fortune to witness two cross-section parties measuring very irregular sections of rock. One was headed by an old-timer, a bundle of energy, who was "all over the lot" assisting his party. The other was an engineering graduate, notebook in hand, simply directing. The outcome favored directing over assisting, two to one in progress made. This was to me an early example in administration. The directing engineering graduate later became general manager of the Lake Shore Railroad.

Snap Judgment Proves Fallible.∼There came into the drafting office in Pueblo one day a somewhat inconspicuous individual with tanned cheeks and a rough homespun suit. He took a seat in the corner to check some items of earthwork computation. Shortly I heard him say, "I can't make these check." As I cast a hasty glance toward him, I hardly wondered. But I was much mistaken. Later I found that he was trained in the Boston engineer's office where I got my start. He became chief engineer for a time on what is now part of the Santa Fe Railway west from Albuquerque, and later chief engineer of the Mexican Central Railway south from El Paso. He was also a man of tested courage. This experience taught me not to make snap judgments on too meager data, a lesson that I found generally useful, and especially desirable in sizing up students.

It was my habit, while in the West, to become a part of the community in which I happened to live, even for a short time—a course which has value in one's general development, or shall we say, in one's education. It added much to the comfort of life there. While in Santa Fe in a literary society which I had joined, I heard, before publication, some extracts from *Ben Hur* read by its author, Gen. Lew Wallace, then governor of New Mexico.

Valuable Contacts.∼It fell to my lot at one time to study law and to be admitted to the bar in New Mexico, and later in Massachusetts. I am still of the opinion that an engineering education develops an analytical habit of mind appropriate for ferreting out what the law is in a given case. I also elected to serve as a bank clerk for a limited period.

On my return to Boston about fifteen years after graduation, due perhaps to what has been termed a "gang instinct" it became my habit to join a number of societies classed as engineering, semi-engineering, and otherwise. Such associations have reacted favorably on my teaching, often very directly. My interest and activity in them has received practical appreciation, and the result has been, I believe, favorable so far as respect for the profession of engineering is concerned.

A wide diversity of occupation, of location, of personal, social, and human conditions—all these have contributed somewhat to my equipment as a teacher. Continuing attendance at meetings of engineering societies has provided needed contacts with men, and these, together with necessary attention to family and personal interests, have enabled me to escape the letdown which has proved fatal to so many who of necessity have ceased active service late in life. The 23 years since my retirement have been years of happiness and enjoyment lasting even until now.

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Volume 9

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July 1939

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Number 7

The Santee-Cooper Project, South Carolina

State Public Service Authority Begins Construction of Multi-Purpose River Development; 180,000-kva Power Plant and Inland Waterway Are Principal Features

From a Paper Before the 1939 Annual Meeting of the North Carolina Section

By Kenneth Markwell
Project Engineer, Santee–Cooper Project, Federal Emergency Administration of Public Works, Charleston, S.C.

Notable in several ways is the Santee-Cooper Project, now under construction in South Carolina. It will be the first large hydroelectric installation below the fall line in the southeastern states, and the first such project anywhere in the country to be owned and operated by a state-created authority. In addition to power, it will provide flood control and reclamation for a large area, and an inland waterway between Charleston and Columbia. Of historical interest in the latter connection is the fact that the "first internal improvement in the country" was the old Santee Canal, built in 1800 to link these same two cities. More than 16,000,000 cu yd of earth and sand fill will go into the dams and dikes of the Santee-Cooper Project, and a somewhat greater quantity of excavation will be required in the construction of the canals and channel improvements.

The Santee-Cooper Project, a multi-purpose development of the Santee River (South Carolina), was placed under construction in August 1938. Estimated to cost upwards of $40,000,000, it will include power and navigation facilities and provide flood control and reclamation benefits for a large area. A general description of this project and a brief review of its history are included in the present article.

The region in which the development is located (Fig. 1) was among the first in America to be settled, and long before the advent of railroads and adequate highways a canal from the upper Cooper River to the Santee was conceived for the purpose of shortening the water route between Charleston and Columbia. This canal, chartered in 1786, was completed in 1800. It had a width of about 10 ft at the locks—of which there were 11—and the depth of water provided was 4 ft.

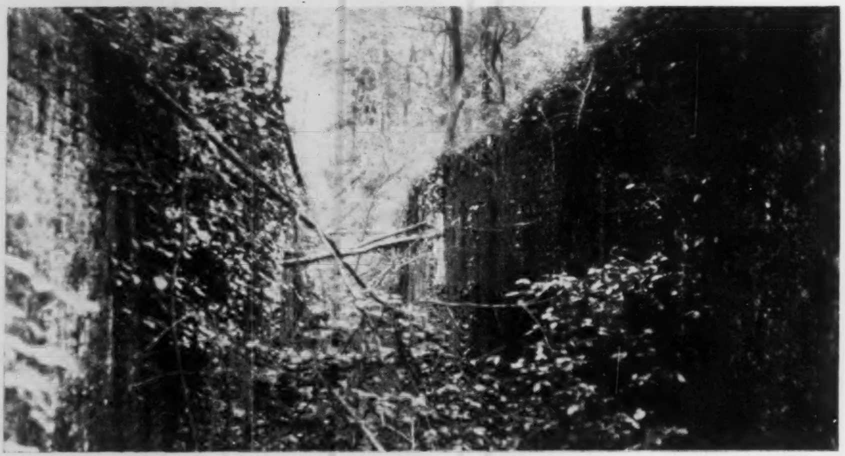
The best business year for the old Santee Canal was 1830, during which 750 boats were handled, carrying principally farm products, of which 79,000 bales of cotton constituted the major portion. Shortly afterward the railroad from Columbia to Charleston was completed, and since the facilities of the canal prevented it from seriously competing with the railroad, it ceased operation in 1850. Nevertheless, the desire for cheap water-borne traffic has continued until the present.

In 1886 the project for improving the Congaree River was adopted and provided for a navigable depth of 4 ft at low water from Georgetown to Columbia. About 1904 a company placed boats in operation between Georgetown and Columbia on the Santee River, and in 1913 the Columbia Railway and Navigation Company established a line of shallow-draft steamers, also operating between Georgetown and Columbia.

In 1914 a dam was constructed across the Broad River, upstream from Columbia, which so regulated discharge that at times only a 2-ft depth was available in the Santee. With that development, regular navigation ceased.

Typical of the Reservoir Area Is This View Along the Future Center Line of the Santee Spillway Dam

The Santee River—Looking Upstream Toward the Proposed Point of Discharge of the Santee Spillway



IN SERVICE IN 1800 WAS THIS LOCK ON THE OLD SANTEE CANAL, WHICH LINKED COLUMBIA AND CHARLESTON, S.C.

A Modern Waterway Between the Same Two Cities Will Be an Incidental Feature of the Power Development Now Under Construction

In 1928 the federal government completed the section of the Intra-Coastal Waterway between Georgetown and Charleston. This waterway, 90 ft wide and 10 ft deep, forms an excellent coastal feeder between Charleston and Georgetown in connection with river waterways to interior points such as the Cooper, Santee, Pee Dee, and Waccamaw rivers; nevertheless it has not been utilized to its full capacity because of the inadequacy of the river routes to the Piedmont District of the Carolinas—the industrial region of the southeastern states.

In April 1926 the Federal Power Commission granted to the Columbia Railway and Navigation Company a license to construct a power development in the vicinity of Ferguson and Pinopolis, S.C. This project involved diversion of the flow of the Santee River to the Cooper River by means of a canal through Greenhill Swamp, and the license required the company to provide 10-ft navigation between the two rivers.

STATE PUBLIC SERVICE AUTHORITY ORGANIZED TO CONSTRUCT PROJECT

In 1934 the South Carolina Public Service Authority was organized by an act of the state legislature to acquire the properties and rights of the Columbia Railway and Navigation Company and to construct the proposed works. It is under these auspices that the project is now going forward. Application for a loan and grant of approximately $36,000,000 to finance the construction was made to the Federal Emergency Administration of Public Works in October 1934, and subsequently a loan and grant was made by the Public Works Administration for $34,300,000, exclusive of land clearing. To perform this part of the work, the Works Progress Administration has alloted $6,000,000.

The drainage area of the project is approximately 15,000 sq miles. Two large reservoirs will be formed by the construction of dams across the Santee River and the Pinopolis basin. The Santee Reservoir will cover an area of about 155 sq miles with a maximum depth of about 35 ft. The Pinopolis Reservoir will cover an area of about 95 sq miles with a maximum depth of about 65 ft. Between the two reservoirs a diversion canal about $7^1/_2$ miles in length will be excavated. This canal will have a mean bottom width of 200 ft, side slopes of 1 on $1^1/_2$, and a minimum depth of water of at least 10 ft. It will serve as a navigation channel between the two reservoirs and will also supply the water necessary for power development facilities at the Pinopolis power station.

THIRTY-SIX MILES OF DAMS AND DIKES

The Santee Diversion Dam, across the Santee River near Wilson Landing, will be about 8 miles in length, and will have a maximum height of 45 ft. It is to consist of a pumped sand-fill portion about 23,000 ft long, on the north side of the river; a spillway about 3,400 ft long, at the river; and a rolled earth fill portion about 16,000 ft long, extending from the south end of the spillway to the south abutment. The spillway will be of the reinforced-concrete sloping-deck type, equipped with steel crest gates and operating mechanism to properly regulate the Santee lake level for power and navigation purposes. It will be capable of discharging safely a possible maximum flood of 800,000 cu ft per sec—more than twice the greatest of record.

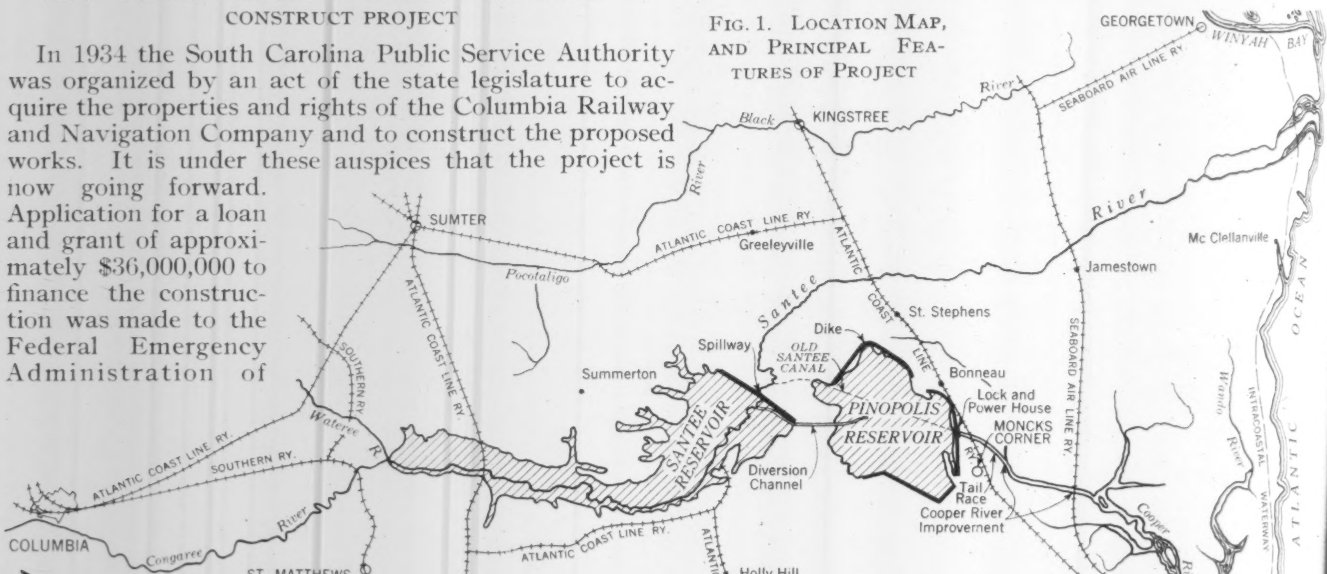


FIG. 1. LOCATION MAP, AND PRINCIPAL FEATURES OF PROJECT

GEORGETOWN
WINYAH BAY
SEABOARD AIR LINE RY.
River
Black River
KINGSTREE
SUMTER
ATLANTIC COAST LINE RY.
Greeleyville
Pocotaligo
River
Mc Clellanville
Jamestown
Santee
St. Stephens
Dike
Spillway
OLD SANTEE CANAL
Bonneau
Summerton
PINOPOLIS RESERVOIR
Lock and Power House
MONCKS CORNER
SANTEE RESERVOIR
Diversion Channel
Tail Race
Cooper River Improvement
Wateree R.
SOUTHERN RY.
COLUMBIA
Congaree River
ST. MATTHEWS
CAMERON
Holly Hill
ORANGEBURG
Harleyville
Jedburg
Ridgeville
Summerville
Pregnall
Rosinville
CHARLESTON
ATLANTIC COAST LINE RY
SEABOARD AIR LINE RY
Cooper River
Wando River
INTRACOASTAL WATERWAY
ATLANTIC OCEAN
0 5 10 15 20
Scale in Miles

The Pinopolis Dam will be about two miles in length, and will consist of two rolled earth fill sections (maximum height 73 ft) between which will be constructed the reinforced concrete power station and the navigation lock. About 26 miles of earth dikes will also be constructed around the Pinopolis Reservoir to properly confine the lake waters and prevent the formation of objectionably large shallow areas along portions of the short line.

The tail canal below the power station will extend about $4^{1}/_{2}$ miles to the Cooper River, along which some channel improvements will be necessary for an additional distance of approximately 10 miles to provide a minimum navigable depth of at least 10 ft from the lock at the power station to Charleston. The tail canal and Cooper River improvement will have an average bottom width of about 320 ft and will be of ample cross-section to provide for a flow of about 33,000 cu ft per sec when all generating units in the power station are in operation.

Navigation requirements make it necessary to so proportion both the diversion canal between the two reservoirs and the tail canal from the power station to Cooper River, that the velocities of flow in these channels, under maximum operating conditions at the power station, shall not exceed 3 miles per hr, in order that no objectionable currents will be encountered by craft using the waterway.

The average flow of the Santee River for the 28 years of record between 1908 and 1936 is 18,900 cu ft per sec.

By the Middle of May 1939, Stripping Was in Progress on the East End of East Pinopolis Dam

The calendar years 1926 and 1927 both show a total stream flow considerably less than any previous or subsequent calendar year of record, while the water year 1926–1927 had an average flow of 9,780 cu ft per sec, which is considerably lower than any other water year of record.

The approximate stream flow equivalent to a firm output of 450,000,000 kwhr per year at the high tension power plant bus is 11,000 cu ft per sec. It is significant that, in addition to 1926–1927, only one other water year in the period of record had an average stream flow of less than that amount (1910–1911; 10,800 cu ft per sec). It is also significant that the stream flow required for firm power—11,000 cu ft per sec—is only $57^{1}/_{2}$ per cent of the average flow during the years of record, and should be available without storage for 95 per cent of the time.

Present plans for power facilities call for an ultimate installation of 213,300 hp of turbine capacity, divided as follows:

Three 40,000-hp units, fixed-blade propeller type, 120 rpm
Two 40,000-hp units, adjustable-blade propeller type, 120 rpm
One 13,300-hp unit, adjustable-blade propeller type, 200 rpm

Ox-Cart Transportation Is Still Common in the Area to Be Occupied by the Development

All these units are rated at 70-ft head, and the operating head will vary between 50 and 75 ft. Generator capacity will include five 34,000-kva units (90 per cent power factor) and one 11,350-kva unit.

The power station will be approximately 380 ft in length, of conventional design. The substructure will be constructed of reinforced concrete throughout and founded upon limestone. The intake portion will consist of concrete dividing walls surmounted by a combination fender wall and crane girder at the upstream face, with the usual steel trash racks, stop-logs, and vertical steel head-gates operated by an outdoor-type traveling gantry crane. A steel and brick superstructure will provide complete housing of all generating units, while the transformers will be located on the downstream deck of the power station, directly over the draft tubes.

Present plans provide for a one-lift lock chamber, constructed of concrete and located at the southwest end of the power station. The lock chamber will be 60 ft wide and 180 ft long and will provide for lifting or lowering vessels 75 ft. When completed, it will have the distinction of being the highest single-lift lock in existence. This will be the only lockage facility required in the 150-mile waterway between Charleston on the coast, and the city of Columbia. However, to secure a minimum navigable depth of 10 ft in the last 50 miles—that is, in the Congaree River above the head of the Santee Reservoir—some additional channel improvements will be necessary.

TIMBER SALVAGE, POPULATION RESETTLEMENT, AND MALARIA CONTROL ARE IMPORTANT ITEMS

The creation of these two large reservoirs necessitates acquiring and improving approximately 180,000 acres of land and clearing approximately 106,500 acres of marginal, swamp, and other areas.

In connection with the acquisition of land, it will be necessary to salvage more than 200,000,000 fbm of timber. Nearly all kinds of timber indigenous to coastal North Carolina, South Carolina, and Georgia are available from this area. Cypress, gums (red, black, and tupelo), sycamore, ash, white oak, red oak, and water oak are the principal commercial varieties. The cypress, sycamore, and gums will produce lumber of all commercial grades; the oak is mostly of a low grade. There is some pine, both long and short leaf, remaining in the area, but original stands of these woods are not in great abundance. Plans are in progress to dispose of merchantable timber through local sawmills which have the proper facilities. There will, of course, be a large amount of pulp wood from the small pine which will be used by the pulp mills nearby.

Another difficult feature of land acquisition is that it will be necessary to resettle some 500 familes who now subsist on small farms in the basins. Constructing 500 farms to suit as many families is not a small job.

This project is the first large hydroelectric development to be constructed below the fall line in the southeastern states and, because of its lowland location, presents a far greater problem from the standpoint of malaria control than previous hydroelectric developments in the upland regions. Because this is the case, unusual measures are being taken by the Authority to control malaria-carrying mosquitoes and for the general sanitation of the region. Minor drainage as well as the use of larvicide and other means are being employed to control the breeding of mosquitoes. This work has already been started under the direction of Dr. L. L. Williams of the U. S. Public Health Service, and the Authority has employed, in addition, an entomologist, a botanist, a bacteriologist, and an engineer who are going into every phase of the work in the greatest detail, using the latest scientific methods. All employees on the project will be tested periodically for malaria infection, as well as for syphilis, and facilities will be provided for treating these diseases. Individuals who do not wish to take treatment will not be permitted to work on the project.

TYPICAL NEGRO DWELLING IN THE RESERVOIR AREA
Plans Are Being Made to Rehabilitate Some 500 Families on Neighboring Lands

A PROJECT OF "BALANCED BENEFITS"

The territory directly tributary to the Santee-Cooper project has an area of 32,000 sq miles and contains a population of over two million.

The annual potential freight movement that will be available to the waterway is estimated to be in excess of 1,600,000 tons. Heavy commodities such as cotton, fertilizer, and cement should predominate. The Authority contemplates that there will be a general increase in freight movement on completion of the project, due to the stimulation afforded by a lower water rate to the center of the state. It is believed that this will remove some of the present freight-rate barriers, which are now retarding the development of the area. While it is probable that the freight moved by the new waterway will at first be competitive, its general effect on equalizing freight rates in this area with those in other sections of the country is expected to generally stimulate business, furthering the general growth of industries in the region.

The power development feature of the project will provide cheaper power within a 200-mile radius of Charleston. Contracts for the sale of electricity have not yet been entered into, but the Authority contemplates a general-system business, both wholesale and retail. It points out in its application to the Public Works Administration that the availability of cheap power should have a stimulating influence on all industries in which the price of power enters largely into that of the completed product.

It may be expected that the major portion of the benefits from the power development will accrue to the coastal region. On the other hand, the navigation feature should stimulate primarily the up-state and Piedmont areas. Thus a balanced benefit to all sections within a 200-mile radius of Charleston should result.

To summarize, the project in general has seven principal features:

1. A power development capable of producing 450,000,000 kwhr of firm power annually (and 700,000,000 kwhr of total energy in a year of average stream flow) at a cost which will greatly benefit the coastal region.
2. An inland waterway between Charleston and Georgetown, on the coast, and Columbia, having a minimum channel depth of 10 ft from the coast to the junction of the Congaree and Wateree rivers, and a navigable depth of 7 ft in the Congaree River to Columbia.
3. Flood control and reclamation. The Authority contemplates a considerable reduction in flood frequency and severity in the Santee delta, below the diversion dam, which should add to the value of this area for such purposes as trucking and general intensified farming. In addition, more than 160,000 acres of rich alluvial bottom lands are to be reclaimed in the lower delta of the Santee. These lands are exceedingly fertile and will be suitable, when drained, for all types of truck, as well as rice and many other field crops.
4. Health betterment, afforded by utilizing the methods adopted at Lake Murray (S.C.) and by the Tennessee Valley Authority for mosquito control.
5. Recreational facilities. These will be provided through the creation of two large lakes available to the inhabitants of the state for boating, fishing, and hunting
6. Reforestation. The project will require a considerable acreage of marginal lands in addition to those overflowed by the reservoirs and a reforestation plan for them will greatly aid in compensating for the depletion of the timber resources of this section of the country.
7. Aid to national defense. The project will be of considerable aid in national defense, not only in making available a large supply of cheap power for industrial purposes but in supplying an additional transportation facility between the important port of Charleston and the industrial sections of the Carolinas.

Up to June 12, 1939, contracts totaling $7,455,250 had been awarded for work on the Santee-Cooper Project. These include contracts for the construction of four 40,000-hp turbines and one 13,300-hp turbine and the corresponding generating units, and construction contracts for the power house, lock, east and west dams, and entrance road in the Pinopolis basin. Construction was begun at the Pinopolis site on May 8, and stripping of the dam area and construction of the rolled earth fill of the east dam is now in progress. Under present plans, contracts for all major parts of the work, including the Santee Diversion Dam, will have been let by September 30, 1939, and the project is expected to be substantially completed by June 29, 1941.

Observational Versus Experimental Hydraulics

By Gerard H. Matthes

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A bathing suit and a pair of waders are excellent equipment for the study of hydraulic phenomena, says Mr. Matthes in presenting this plea for a revival of interest in field investigations. Observational hydraulics, he points out, has been on the decline since the advent of the laboratory—yet in many problems "a more direct and dependable answer might be obtained through field investigation alone." This is not said in condemnation of model experimentation; the point is rather that in recent years one type of research has been emphasized at the expense of another, whereas the two forms are actually largely interdependent. An interesting list of problems that the laboratory cannot solve without assistance from field observations is presented, and the need for installation of observational facilities in hydraulic structures is stressed. This article was on the program of the Hydraulics Division at the 1939 Spring Meeting.

THIS paper is in the nature of a plea addressed to hydraulic engineers and scientists to revive interest in field study of hydraulic phenomena. This form of research, which draws its conclusions from observations made in nature, whether on natural or artificial channels or at structures, is here denoted "observational hydraulics" to differentiate it from "experimental hydraulics," which draws its conclusions from experiments made on laboratory models. These two forms of research are largely interdependent; the one cannot succeed or progress without assistance from the other; taken singly neither gives complete answers but taken together they make possible a fair approach to complete answers. Viewed broadly the laboratory cannot solve its problems without assistance from the field. Also, there are problems which are completely beyond the laboratory's abilities, either with or without field assistance.

Experimental models are handicapped by well-known limitations which need not be enumerated here. Many a costly model has given but a partial, or at best inconclusive answer for lack of sufficient field data. This refers not so much to dimensional data for use in model construction as to data of the observational kind needed for proper operation and interpretation of results.

By observational data is here meant information obtained by observations on the prototype relating to specific phenomena—taking note of their magnitude, times and conditions of occurrence. For instance, in a model involving the simulation of tides, very complete series of field observations are required in order that the tidal phenomena may be correctly reproduced. Again, in the case of models of harbors, ample field observations on wind effects are needed. An interesting case is that of the bar which forms annually at the head of Southwest Pass (one of the delta outlets of the Mississippi River). This bar builds up through deposition of fine silt particles during ordinary stages and becomes highly compacted during the low-water season. During early flood stages it resists erosion but finally yields to scour according to field observations, whenever the Mississippi River attains a stage of about 13 ft on the Carrollton gage at New Orleans. It does not then rebuild until after the flood season. No river model could be expected to reproduce such a cycle without assistance from its operator. The latter, without the guidance of ample field observations, would be sure to be led into misinterpretation of the model's action.

The need for testing the performance of completed engineering works in the design of which reliance was placed on model experimentation cannot be overemphasized. Field observations alone can determine whether or not this performance confirms the solutions obtained from the models. Instances exist of structures built at great cost and for which costly experimental studies were made, in which no provision exists for making such confirmation tests. This not only leaves the correctness of the performance of the structures in doubt, but reduces the value of the experimental work, as it establishes no dependable guide for future experimentation of the same kind.

The situation which confronts hydraulic engineers is well illustrated by reference to the evolution of our knowledge of river hydraulics. Before the days of the laboratory, engineers were compelled to gain information by studying natural streams, and observational hydraulics reached its peak. The early works of Guglielmini (1697) and of Frisi (1762) on river hydraulics, based mostly on direct observations on the river Po in Italy; similar observations made on the Mississippi River by Humphreys and Abbott (1861); and the studies of M. P. Du Boys on the Rhône in France (1879), although now outmoded, still stand as the classics of observational hydraulics. Other worth-while contributions followed later, but since the advent of the laboratory there has been a steadily growing tendency on the part of engineers and scientists to rely on laboratory models for answers to involved problems instead of spending time and money on field observations. Laboratory investigations on stream-flow phenomena, today, are greatly in need of better basic information from direct field observations. This is particularly true as regards velocity distribution, transportation of sediment, turbulence, bed scour, and bar building.

OPPORTUNITIES NOW ARE EXCEPTIONALLY FAVORABLE

This plea for reviving interest in field study of hydraulic phenomena is submitted at this particular time because the potentialities afforded for observational hydraulics in this era of great hydraulic development are exceptionally favorable, yet are not being taken advantage of as they should be.

It is up to our laboratory experts to insist on more complete information from the prototype for use in conducting their investigations. Laboratory tests should be supplemented more frequently by contemporaneous observational work in the field , and this should be of a high order and planned in collaboration with laboratory experts to form an integral part of the investigation.

In many cases the laboratory expert would gain prestige by showing the engineer who hands him a knotty problem that a more direct and dependable answer might be obtained through field investigation alone, if properly conducted. For certain problems it will be found that there is no great difference in cost or time between a field study and a model study, once the technique of conducting the field study has been acquired. Such field technique is today almost non-existent and needs developing. Should the field investigation appear more costly than the laboratory estimate, the additional cost should be weighed against the superior advantage of getting an answer direct from undistorted field conditions. Such cases may not present themselves often, but should receive more consideration than has been accorded them. The tacit assumption that only a model can furnish answers to involved hydraulic problems is unwarranted.

The plea for more field observation applies to hydraulic structures as much as to river problems. The rapidly increasing number of such structures as high dams, spillways, locks, gate installations, tunnels, conduits, siphons, and bridge piers, now being erected throughout the United States, afford an exceptionally diversified field for observing hydraulic phenomena at the completed structures. As already stated, observations of this type are necessary to verify the results obtained from model tests; in addition, they are needed to fortify design practice, to increase our knowledge of hydraulic coefficients, and to clarify hydraulic principles as yet imperfectly understood.

Many engineers have urged that observations be made at completed structures, but the facilities for making them have rarely been provided. This is because money for construction purposes is limited, and once a structure is completed, it is doubly hard to get funds for supplying additional installations for testing purposes. This means that the time to provide for facilities for hydraulic observations is during the design and cost-estimating period. All that pertains to gadgets such as gages, Pitot tubes, piezometers, manometers, observation wells, glass windows, and weirs, should be located on the drawings and the necessary fittings included in the construction-cost estimates. Properly planned, the observations can then be made later by the operating personnel without adding measurably to the cost of operation. This plan eliminates the necessity of requesting additional funds for special installations at a time when construction is supposed to be completed.

PROBLEMS REQUIRING FIELD OBSERVATIONS

Following is a partial list of problems that the laboratory cannot solve without assistance from field observations. In some cases the answer will depend almost wholly upon such observations.

1. What forces operate to create scour? Energy forms engaged in sediment transportation and those producing scour are often confused with each other. Small-scale models have been found useful in studying the transportation phenomena, but afford little or no opportunity for making observations on the modus operandi of scour phenomena. As these are by far the more important in river and harbor engineering and are but imperfectly understood, there is need of studying these phenomena by direct observations in nature.
2. Turbulence is a generic term applied to a variety of hydraulic phenomena which need differentiating. The terminology is unfortunate and has become responsible for apparent confusion. Certain types of turbulence are of prime importance in practical engineering problems. It is doubtful whether the laboratory can supply the needed information without supplementary field study.
3. Transverse oscillation of the water surface in rivers and its bearing on channel sinuosity appear to be little understood. The relation is fundamental to natural channel morphology, but so far no practical use is made of it in river engineering because it is not capable of satisfactory analysis through the medium of models. Field observations appear to offer a practicable means of study.
4. Negative pressures in stream flow and at structures have received little attention. In rivers negative pressures are found at eddies, downstream from boulders, and at falls. At structures, negative pressures occur in conduits, at gates and at spillways, and in some instances cavitation phenomena assume importance. Small-scale models are not suited to reproducing such phenomena adequately, and field study is needed to enlighten the designer of structures as well as the river hydraulician.
5. Coefficients in weir formulas for deep flow over various types of dam crests and at spillways still offer a wide field of endeavor for observational hydraulics.
6. Problems of high velocity at structures, entrainment of air, and related phenomena cannot be studied satisfactorily by means of models.

COOPERATION OF LABORATORY EXPERTS NEEDED

The writer would recommend closer contact between hydraulic engineers and hydraulic laboratory experts. Such cooperation has many aspects which cannot be covered within the scope of this paper. By way of illustration, consider the establishment of a gage at a completed structure or in an open river. If left to the field engineer's judgment, the location of the gage will rarely fulfill the requirements for good hydraulic observation because, being a practical man, the engineer will be guided by such considerations as convenience of access and maintenance. In such a matter the views of a man with good laboratory training will be most helpful in securing a location that will yield the most information under the existing conditions. It is an undeniable fact that the many poorly placed gages on our rivers have contributed largely to the every-day difficulties in applying formulas to natural stream flow. The most sensitive factor in river hydraulics is the hydraulic gradient, and it is seldom correctly determinable because of the haphazard manner in which gages are placed.

An actual example of the value of laboratory advice in the locating of a gage at the outlet of a structure for a dam is of interest in this connection. A laboratory model showed that the most favorable location was quite different from that which would have been considered normally the most convenient—on the walls of the stilling basin. It was shown that standing waves and general turbulence would have defeated the purposes of the gage readings if the instrument had been placed at the latter location.

Even in the location of gages in open rivers, the model can point the way to good advantage. In one instance it was found through model study that a gage located at a river bank indicated water-surface elevations almost one foot lower than the true water surface in the middle of the river, thus affecting any conclusions that might be drawn from its readings relating to hydraulic gradients.

To the student of hydraulics the writer recommends cultivating close acquaintance with mountain streams of the boulder-strewn, clear-water type. These afford opportunities for observing a wide variety of hydraulic phenomena not readily duplicated in laboratory flumes or models of streams. The accessories for such field study consist of a bathing suit and a pair of waders to enable the observer to make observations in midstream and at close range. Observations made at long range from the bank are of little service.

The Multiplex Stretches the Survey Dollar

Economy and Accuracy of Stereoscopic Mapping Method Confirmed by Results of U. S. Geological Survey Work in Tennessee Valley

By T. P. Pendleton

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Of great potential significance to the national mapping program is the topographic work now in progress in the Tennessee Valley, where large-scale maps of superior quality are currently being produced by the Multiplex method at a cost of $70 per sq mile. The work has been in progress for four years, under a cooperative agreement between the U. S. Geological Survey and the Tennessee Valley Authority, and has amply demonstrated the accuracy and economy of the stereophototopographic process. Mr. Pendleton here gives a brief account of the project to date, and concludes with comments on the possible future influence of the Multiplex on national mapping. The article is abridged from a paper presented before the Surveying and Mapping Division at the 1939 Spring Meeting.

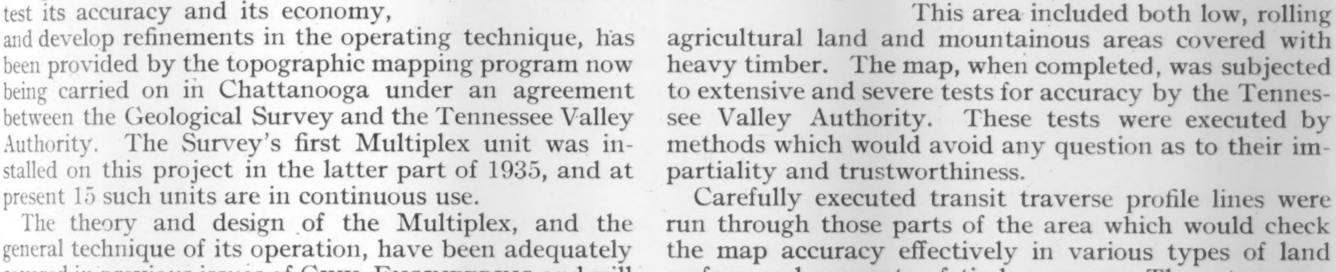
For more than fifty years the U. S. Geological Survey has made use of the plane table as a mapping instrument. However, in recent years attention has been given to the development of mapping processes quite unlike the plane table, which have been definitely proved to have many points of superiority. Practically all the new methods employ aerial photographs, and utilize stereoscopic vision to interpret them. Among these processes, the one that seems best adapted for use in all the different types of terrain encountered by the Survey is that known as the Multiplex method.

An excellent opportunity to study the possibilities of the Multiplex, test its accuracy and its economy, and develop refinements in the operating technique, has been provided by the topographic mapping program now being carried on in Chattanooga under an agreement between the Geological Survey and the Tennessee Valley Authority. The Survey's first Multiplex unit was installed on this project in the latter part of 1935, and at present 15 such units are in continuous use.

The theory and design of the Multiplex, and the general technique of its operation, have been adequately covered in previous issues of Civil Engineering and will not be discussed here. For such information the reader is referred to "Air-Mapping the Brazos River Area," by Eric Haquinius, M. Am. Soc. C.E. (July 1937), and to "Aerial Photographic Mapping by U. S. Geological Survey," a symposium by Joseph Hyde Pratt, M. Am. Soc. C.E., and W. S. Higginson (October 1938). The present paper comprises, rather, a "progress report" on the Chattanooga work, and a brief discussion of the possible future effects of the Multiplex on the nationwide operations of the Geological Survey.

As one of the first steps in the Chattanooga work, a quadrangle of varied terrain, containing 60 sq miles, was selected as the area in which to determine the accuracy attainable with the instrument. This area included both low, rolling agricultural land and mountainous areas covered with heavy timber. The map, when completed, was subjected to extensive and severe tests for accuracy by the Tennessee Valley Authority. These tests were executed by methods which would avoid any question as to their impartiality and trustworthiness.

Carefully executed transit traverse profile lines were run through those parts of the area which would check the map accuracy effectively in various types of land surface and amounts of timber cover. These traverses were tied to previously established transit traverse sta-



VERTICAL ACCURACY

	Number	Percentage
Test Points Correct Within One-Half Contour Interval	66	94.3
Test Points in Error Between One-Half and Full Contour Interval	4	5.7
Test Points in Error by More Than Full Contour Interval	0	0
Total	70	100.0

	Feet	Percentage
Length of Profile Correct Within One-Half Contour Interval	8 959	98.5
Length of Profile in Error Between One-Half and Full Contour Interval	135	1.5
Length of Profile in Error by More Than Full Contour Interval	0	0
Total	9 094	100.0

Number of Plus Errors	44	Σ Plus Errors	+218 Ft	Average Plus Error	+5.0 Ft
Number of Minus Errors	26	Σ Minus Errors	−113 Ft	Average Minus Error	−4.3 Ft
Total	70	Difference	+105 Ft	Difference	+0.7 Ft

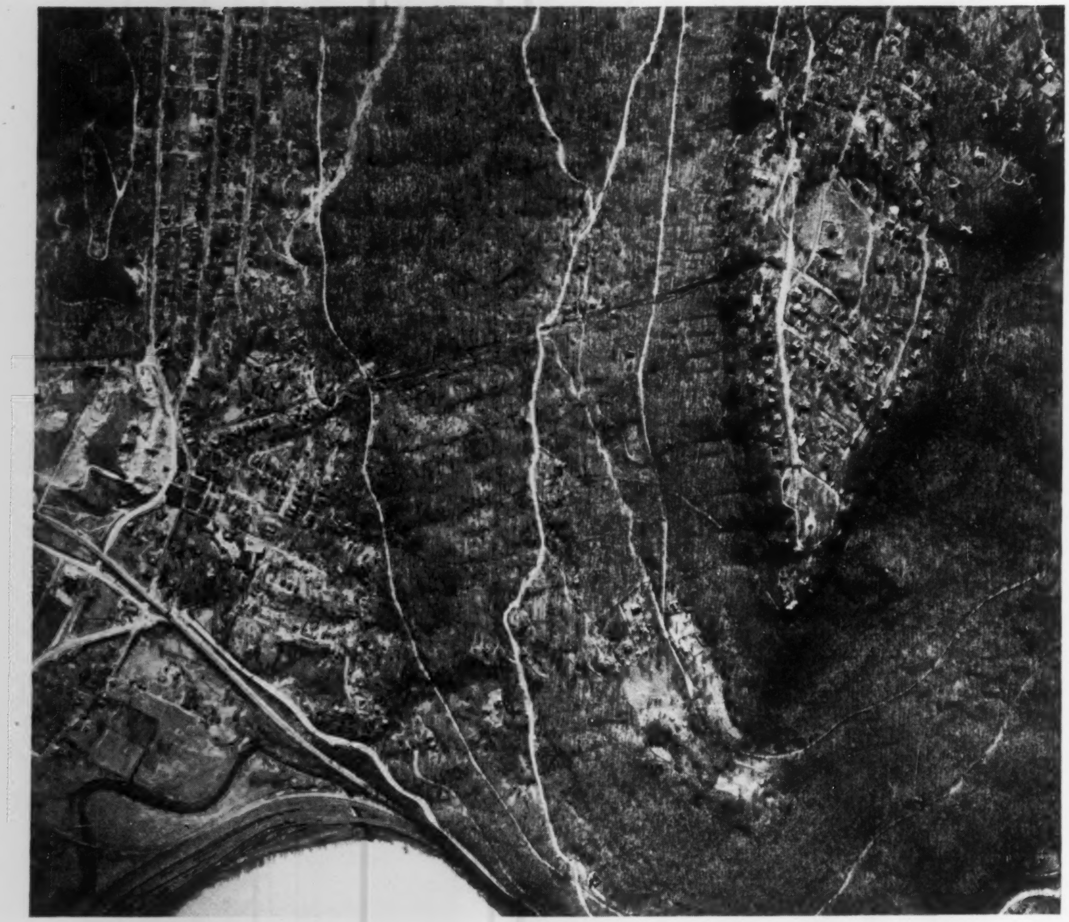
Average Error per Test Point 4.7 Ft
Maximum Error 18 Ft

HORIZONTAL ACCURACY (Cultural Features, Roads, Etc.)

	Number	Percentage
Test Positions Correct Within $\frac{1''}{50}$ on 1 : 24 000 Scale	5	100
Test Positions in Error by More Than $\frac{1''}{50}$ on 1 : 24 000 Scale	0	0
Total	5	100.0

Average Position Error on 1 : 24 000 Scale, 0.006 In.
Maximum Position Error on 1 : 24 000 Scale, 0.015 In.

Fig. I. Profile Test of Map Drawn by the Multiplex Instrument



AERIAL VIEW OF LOOKOUT MOUNTAIN, SHOWING THE GREAT DETAIL REVEALED IN A HEAVILY WOODED AREA BY WINTER PHOTOGRAPHY

tions and adjusted for closure both in position and elevation. The traverse-men carried out this profile work in such a way as to obtain good delineation of the slope of the land surface, and accurately located on the profile many well-defined cultural and drainage features. A profile was drawn in the customary manner and the coordinates of all points in the traverse at which changes of direction occurred were supplied to the Geological Survey in order that these points could be accurately plotted on the Multiplex drawing to define the position of the traverse. A profile was then taken from this drawing by interpolating elevations at all places where a change of slope was indicated, and making plus-distance measurements to all cultural and drainage features. The Tennessee Valley Authority superimposed this map profile over the transit traverse profile and analyzed the discrepancies in elevation and position that were revealed throughout the line. The total length of such profile lines on this test quadrangle was about 21 miles.

SPECIFICATIONS FOR ACCURACY MET, TESTS SHOW

These tests cannot be described in detail, but it can be said that each test revealed that the map was in good accord with the specifications for accuracy that had been set up by the Authority as indicative of its needs. These specifications were that 90 per cent of the tested points should not show differences in elevation greater than one-half the contour interval, while horizontal errors should not exceed 0.02 in. at the publication scale. The average vertical differences revealed by tests of 10-ft and 25-ft contour lines at 667 points was 4.1 ft, and it was noted that there was a remarkably even balance between the plus and minus errors. The average error in position at the scale of 1:24,000, the publication scale for this map, was 0.007 in., which was well below the permissible tolerance. (A typical test profile is shown in Fig. 1.)

These results were so satisfactory that the Authority decided to carry out all its topographic map work by photogrammetric methods if the necessary equipment could be secured and if tests revealed that the method was economical and sufficiently accurate for use in areas of low relief. The Geological Survey fortunately was able to get a small amount of additional apparatus during 1937 and since then has been able to add to this materially. During the fiscal year ending June 30, 1939, fifteen trained operators have turned out about 1,900 sq miles of rather detailed maps showing 20-ft contour lines at an original scale of 1:10,000. This is an excellent rate when compared with plane-table production at much smaller scales, and the few tests that have been made indicate that the Multiplex map stands the profile test better than the plane-table map. The new method has other advantages too, of which not the least important are freedom from delay due to bad weather, and avoidance of all the handicaps and difficulties that the topographer must contend with in his effort to delineate land forms accurately.

Contours are drawn with the Multiplex by moving a "floating mark" in a stereoscopic field of view in such manner as to keep it in apparent contact with the surface of the stereoscopic model at a predetermined elevation. This method of contouring is superior, in most types of terrain, to that employed with the plane table, in which a topographer secures a limited number of controlling positions and elevations in the area immediately adjacent to a station and sketches the contour lines on the map, using the country before him as a model and the located positions as a guide. There is no indication on Multiplex maps of a style peculiar to individual operators—a fault so customary in plane-table work that it has been frequently said that the appearance of each topographer's work is sufficiently distinctive to identify him as its author.

Multiplex mapping necessitates the use of a relatively large map scale for the original drawing. This cannot be avoided at the present time because it is dependent upon the service ceiling at which commercial airplanes commonly employed for aerial photography can operate. However, a large scale has many advantages because it enables the operator to delineate cultural features in proper size and thus avoids exaggeration at places where the detail is minute. The operator can therefore work more rapidly than he could if forced to pencil very carefully in order to represent fine detail. These larger map scales and the facility with which cultural information can be shown on them make it desirable to show definite fence and section lines on the map, as this information is of material advantage in making the completion survey preparatory to the publication of the map, and also for many engineering and land acquisition uses. This type of information is not shown on the published map but is preserved on the original drawing, and may have a very real value in the future should there be occasion to publish the maps at larger scales and in greater detail than is the present practice.

ECONOMY IN COST, ANOTHER ADVANTAGE OF METHOD

Another advantage secured by the Multiplex method is the reduced cost at which the work can be done. It is not possible to give definite figures for various types of terrain, because all work completed to date has been in the Tennessee Valley and work elsewhere might cost more or less. The present cooperative arrangement is such that the Geological Survey performs only the map-drawing operation, leaving to the Authority all survey work essential to the establishment of horizontal and vertical control, and the so-called completion survey operation, which is a necessary step in the production of a map by stereoscopic methods. However, under the conditions that apply in rather hilly land a part of which is wooded, the average cost per square mile for the operation of the Multiplex instruments during the past eight months has been about $26 per sq mile. This includes all charges against this operation by the Survey. The cost has gradually declined throughout the year, indicating continual improvement in the speed and skill of the various operators. By adding informal figures secured from the Authority and editorial expense on the maps, the total cost exclusive of reproduction is in the neighborhood of $70 per sq mile for this area. Further reduction in these costs can be anticipated through use of a new, wide-angle camera specially designed for stereoscopic mapping, which will materially decrease the number of photographs to be processed and the amount of field control required.

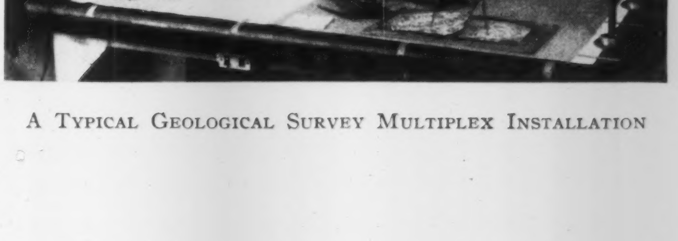
The Geological Survey has performed only a small amount of mapping in mountainous areas where 40 and 50-ft contour lines are appropriate. However, what experience has been acquired has demonstrated definitely that such regions can be mapped rapidly and at a cost less than that for the Tennessee Valley work. Records on hand indicate that the Multiplex drawing step can be done in mountainous areas for approximately $9 per sq mile, and for a total cost materially less than is required for 20-ft contour mapping. This is for work in densely wooded areas such as occur in the vicinity of the Great Smoky Mountains. It is anticipated that in areas of bold relief where timber is sparse the total cost may be further reduced owing to the greater ease with which the necessary horizontal and vertical control can be obtained.

The many advantages of this method indicate definitely that it should be employed to a greater and greater extent. At present it has been developed to the point where it can be used to advantage in all mountainous areas and in low, rolling country where local differences of elevation can be well delineated by 20-ft contour lines. For very flat country where 5- and 10-ft contour lines would be appropriate, it is not proposed to employ this method until it has been shown that the cost of working at this interval will not be unduly great as compared with the plane-table method. For extremely low areas, such as are encountered in coastal regions and elsewhere, the Multiplex can be used advantageously in preparing accurate planimetric bases upon which the topographer can delineate contour lines in much the same manner as has been done for the past fifteen years. However, it should be noted that a planimetric base prepared by the Multiplex method should not be judged for accuracy by similar bases made in the past by the radial line process, because the new method is distinctly superior in accuracy. Thus, the Multiplex is appropriate for topographic work in large areas in the United States and for less favorable localities in preparing base maps for plane-table work.

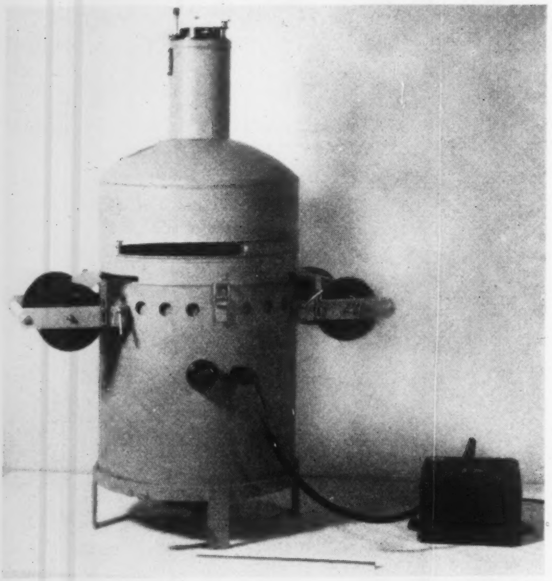
The Multiplex equipment now in Chattanooga is installed in office space provided by the Tennessee Valley Authority, which can be used until the present cooperative agreement is terminated. After some experience with the new method it was decided that the confining nature of the work and the need for a stable relative humidity in the Multiplex rooms made it desirable to establish the office in an air-conditioned building. Fifteen small rooms especially adapted for Multiplex mapping work have been provided with forced ventilation and the special electrical connections demanded by the Multiplex apparatus. A connection to a central air exhaust system is available to properly cool the Multiplex projectors when the full voltage of the lamps is utilized. Each room has a special slate-top table on which is installed a Multiplex bar and several projectors. There is a photographic laboratory equipped with the reduction printers needed in making the small diapositive plates, a small optical laboratory with a 10- by 10-in. coordinate comparator, and a small optical bench with a special observing telescope and collimator for calibrating the equipment. The optical laboratory is also supplied with several microscopes and other testing apparatus which is useful in maintaining the efficiency of the equipment at a high level. Space is provided on a balcony for the control planning operations and the necessary drafting work.

The equipment on hand includes 15 bars to support the Multiplex projectors and a like number of transformers for controlling the current to the projectors. Four of the bars and six of the transformers are of Geological Survey design. The personnel consists of 17 plane-table topographers who have become skilled Multiplex operators, and 15 apprentice operators who are undergoing instruction.

The Multiplex method has convinced the Survey of its usefulness under the conditions confronting the topographer in the United States. When valuable methods such as this become available, it is to be expected that their use will necessitate changes in the operating methods previously employed. Assuming the general adoption of the process, it is of interest to consider what



A Typical Geological Survey Multiplex Installation changes will be necessary in the present operating procedure to make it effective. It will be recognized that mapping by plane table is essentially a field operation, the only office work necessary having to do with the map inking and editorial operations. In the case of the Multiplex, the process is essentially an office one, the only field surveys required having to do with the supplemental control and map completion steps. It has not been necessary for the Survey to maintain permanent field offices for the Topographic Branch except in Sacramento, Calif., although several offices that are used more or less regularly might be properly classed as temporary field offices.



REDUCTION PRINTER USED IN MAKING DIAPOSITIVE PLATES FOR THE MULTIPLEX

With the increase in Multiplex apparatus, it will be necessary to determine whether this work should be concentrated in one very large office, probably located in Washington, D.C., or whether a number of branch field offices should be set up from which work over a considerable radius could be handled conveniently. How many such offices should be established and how large they should be are questions that must be answered at a later time. The field branch office idea has many advantages over a single office established in Washington, as it has been found that the work can be handled most efficiently when done close to the area being mapped, because of the ease of coordinating the control planning, the supplemental control work, and the completion survey operations.

Branch offices should be considered as small production plants not to be handicapped with research problems and the training of personnel, but it must be recognized that for many years it will be necessary to instruct men in the efficient use of the equipment. Inasmuch as the method is relatively new and undoubtedly can be greatly improved with experience and by study of photogrammetric problems, it is essential that a small photogrammetric research division be established. The responsible officials believe that the first field branch office could advantageously be established in Chattanooga, Tenn. It should be sufficiently large to accommodate the research work, the training of new personnel, and all the routine Multiplex map work that is apt to be carried on in the southeastern section of the United States.

It is hoped that future efforts will make such an establishment possible. While the Multiplex equipment now on hand is fully engaged in mapping areas of immediate importance to the Tennessee Valley Authority, nevertheless one of the primary functions of the Survey is to advance the mapping of the United States, and the establishment of such an office would assure continuance of the work in this city for many years after the mapping of the Tennessee Valley has been completed.

WHAT A FIELD BRANCH OFFICE SHOULD INCLUDE

It may be of interest to outline my personal conception of what such an office should include. It is believed that not less than 15 Multiplex bars should eventually be made available for training purposes alone. In addition, 25 to 35 instruments should be provided to handle the map work that might be carried on efficiently from this city. The individual rooms for the photogrammetric equipment must be especially designed to accommodate it but so arranged that they can be readily devoted to other mapping operations if necessary. One photographic laboratory should be provided with a precision camera for map copying operations. In addition to this laboratory, or combined with it, there should be several small photographic laboratories to supply the diapositive plates used in the Multiplex projectors. The optical laboratory need not be large but should be fitted with equipment that would be of service in calibrating the photogrammetric apparatus and useful in connection with problems having to do with research in photogrammetric mapping. A small repair shop is necessary to maintain the equipment in operation.

One of the problems that always confront users of aerial film is that of proper storage. This office and other branch offices as well should be provided with film storage vaults that are fireproof, and so located that if fire does break out in them the fumes can readily be disbursed without endangering the personnel. Proper storage for aerial film to be used in photogrammetric mapping must go further than supplying protection against fire hazards, for such film should be kept in air-conditioned space so controlled as to minimize the detrimental expansion and contraction that so quickly destroy the value of the film for stereoscopic mapping use. A considerable amount of space must naturally be available for drafting work in connection with the preparation of the sheets for reproduction and there must be room for the map files, aerial photograph files, and storage of supplies, surveying equipment, and photogrammetric mapping apparatus. Provision must be made also for the computation of field records, supplemental control planning, and editorial work on the final map sheets, and for clerical and administrative offices.

To accommodate these activities, probably about 34,000 sq ft of office space would be required. The entire building might advantageously be air-conditioned but if this is impossible air conditioning must certainly be made available for the Multiplex rooms and the photographic laboratories and film storage vaults; otherwise the efficiency of the office would be very greatly reduced. An office of this size, when completely staffed, should accommodate a personnel numbering 200.

It may be of interest to estimate roughly the amount of mapping work that an office of this type could handle if it were equipped with 50 Multiplex instruments, all used on actual production and none being reserved for training purposes. Fifty Multiplex instruments operated two shifts per day, on 20-ft contour work, should have an output of 14,400 sq miles per annum of topographic maps for reproduction at scales of 1:24,000 or smaller. In the event that these instruments could be utilized entirely for mountainous regions, the production would probably exceed 42,000 sq miles per annum owing to the increased speed of operation that is possible with a map scale of 1:15,840 and a contour interval of 40 or 50 ft.

Economic Factors in Construction Plant for Buildings

Fifth of a Series on Modern Construction Tools and Practice

By R. L. BERTIN
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
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TRADE-union restrictions on mechanical labor-saving devices regulate to a large extent the development and application of equipment for building construction, says Mr. Bertin, citing examples. But subject to these restrictions, the contractor must formulate the mechanization for his job with the prime purpose of economy in mind. One of the important questions in this connection is whether the contractor should own his equipment or rent it. Only by careful planning of the project as a whole, and of the requisite equipment to carry it out, can the maximum benefits inherent in the use of machinery be realized. The accompanying paper was on the program of the Construction Division at the 1939 Spring Meeting.

AS generally understood, the word "plant" comprises all equipment, including fixtures, machinery, appliances, and tools, in which capital is invested and by which work is accomplished. Applied broadly to the construction industry, "plant" falls into two classes—the manufacturing plant, which embraces such buildings, machines, and tools as are used in converting raw materials into the manufactured products which constitute a structure; and the contractor's plant, which covers the mechanical equipment used at the site to assemble these products into a completed building or structure. The scope of this paper is limited to the latter.

Basically, machines and tools have a place in assembling building parts only in so far as their use reduces the cost of, and the time consumed in, completing the work below that prevailing or required under manual execution. Thus, how much or how little plant is used on a building is influenced by our economic principles, particularly those having to do with our social structure and the relation of capital to labor. Both phases will be reviewed in order to show their influence on the chronological development of plant.

Until comparatively few years ago, buildings were essentially a hand-made product. Timber was hand hewn; cabinet work, doors, windows, and so forth, were patterned by joiners with hand tools; lime and brick were the products of hand work. Buildings in those days were simple in character. The heating equipment, for example, consisted mainly of fireplaces and chimneys, and little if any provision was made for lighting or plumbing. The number of man-hours consumed in constructing a building was relatively high. Men worked ten hours a day and six days a week, and while the hourly rate of pay was low, their earnings were commeasurate with the cost of living.

LABOR-SAVING DEVICES; REACTIONS TO THEIR INTRODUCTION

With the phenomenal growth and prosperity of the country, came an increasing volume of construction work and a desire for greater comforts and luxuries in the form of mechanical appliances such as gas and electric lighting, steam heating, hot and cold running water. It also inspired the use of new materials and more elaborate architectural treatment. All this resulted in a demand for mechanics skilled in trades heretofore unknown. A shortage of labor soon ensued, with consequent increasing wages. This condition was counteracted in part by the invention and introduction of tools and machines with which to supplant manual labor. A case in point is that of the hod carriers, who in the early days supplied the bricklayers with bricks and mortar by carrying these materials in hods up ladders to the brick scaffolds. As time went on, these ladders were replaced by hand-operated chain hoists which did away with the slow and laborious work of climbing ladders. Then platform lifts, raised at first by horses, then by steam, gas, or electricity displaced the chain hoists. Finally, the hod gave place to the more efficient present-day rubber-tired wheelbarrow, and with the hod went the hod carrier, whom we find reborn in the form of the mason laborer and the hoisting engine operator.

The efficiency of labor-saving machinery gradually reduced the need for hand labor, and the organized trades began to counteract the inroads which machinery was making into the demand for the services of their members by reducing the number of working hours per day and the number of work days per week, meanwhile increasing hourly wages in order to maintain average weekly earnings. Thus the development and application of equipment, machinery, and tools to the field work involved in the construction of buildings is regulated to a large extent by the rules which the various trade unions promulgate in order to maintain an adequate earning power for their members. Restrictions on the use of

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ON SOME JOBS, CONCRETE LABORERS HAVE SUCCEEDED IN LIMITING THE DELIVERY OF READY-MIXED CONCRETE TO THE CURB—EVEN THOUGH THE FORMS MAY BE EASILY ACCESSIBLE BY TRUCK

The Added Cost of the Manual Handling May Be as Much as $1.50 per Cu Yd

White Construction Co.

THE CRAWLER CRANE AND TRUCK CRANE HAVE DISPLACED THE GUY DERRICK IN THE ERECTION OF CERTAIN TYPES OF STEEL FRAMES—REDUCING BOTH THE TIME AND THE COST OF ERECTION

mechanical labor-saving devices imposed by certain trade unions in various localities are cited as examples:

Painters have refused to use air brushes for the application of paint. Manual application may be half again as expensive as spraying.

Concrete laborers have been successful in some cases in limiting the delivery of ready mixed concrete to the curb, whence it must be conveyed manually to the forms. This may add from $0.50 to $1.50 per cu yd to the cost of concrete.

Carpenters have refused to handle cut-to-size plywood panels for form work. The greatest loss here is in waste lumber, which may amount to 10 per cent of the total cost of the plywood used.

Metal lathers and steel workers have refused to handle reinforcing steel which is cut to length below certain limits or delivered to the site already bent. Steel bent on the job will cost perhaps $8.00 per ton more than steel bent at the mill.

Plasterers have refused to plaster walls of buildings where smooth concrete ceilings remain unplastered.

Hoisting engine operators have made successful demands not only for the operation of certain equipment, but also for watching equipment which is either automatic or operated by mechanics of the trade the equipment serves—often far beyond actual requirements.

Men who bend the concrete bars have refused to use power benders. Hand bending requires four times as many operators to maintain a given schedule.

All these are striking examples of the controversies which exist between two of the factors in construction plant economics—namely, capital and labor. The solution of these controversies is fortunately not within the scope of this paper; they are mentioned only because of their strong bearing on the type and quantity of equipment which a contractor can use effectively on a given job.

Subject to the restrictions imposed by the trades on the use of machinery, the contractor must formulate the mechanization for the job he has contracted to do. In order to delve into this phase of the subject, it is well to review the evolution of the relation between contractor, architect, and owner.

In the early days of simple structures, the architect was the builder who planned and constructed buildings for owners, generally on a day-labor basis. As the demand for buildings increased and the buildings became larger and more complex, the architect concentrated his efforts on planning the structure, and delegated the work of construction to a builder or general contractor, either for a lump sum, or at cost plus a fee, or for a percentage with or without a guaranteed top cost.

Later there came into being a great number of contractors who specialized in some branch of the industry, and correspondingly, the mechanics classified themselves into separate trade unions, each specializing in some one trade, until today there are no less than 35 to 40 trade unions and 60 to 70 distinct classes of subcontractors. The function of the builder or general contractor under these conditions has become a complex one. In addition to doing a certain amount of the work himself, generally the mason work, he is called upon to guarantee the faithful performance of all the subcontractors required to complete the structure, and to guarantee their work for a period of one or more years. This requires large financial resources.

Thus we find the building industry today composed of general contractors and of subcontractors who specialize in one or more branches of the industry, each using appropriate equipment with which to carry on his share of the work of creating a building.

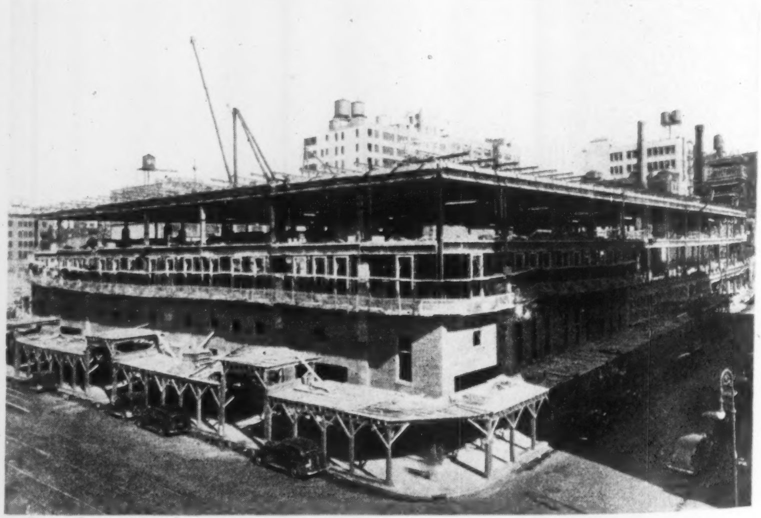
EQUIPMENT REQUIRED BY VARIOUS TRADES

The nature of some of the trades is such as to require a considerable amount of costly equipment—as witness the following schedule:

Excavation—Steam or motor driven gas shovels; air compressors; trucks; steam boilers, pumps; derricks; air or steam drills and hammers; dust eliminators; cranes.

Pile Drivers—Pile rigs to suit the type of pile; air compressors; steam boilers; trucks; pumps.

Steel Erectors—Cranes; derricks; hoists; compressors; welding equipment.



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WORKING IN BUSY STREETS AND WITH NO STORAGE YARD AT HAND, THE BUILDING CONTRACTOR MUST SCHEDULE HIS DELIVERIES OF MATERIAL WITH GREAT CARE TO MINIMIZE REHANDLING

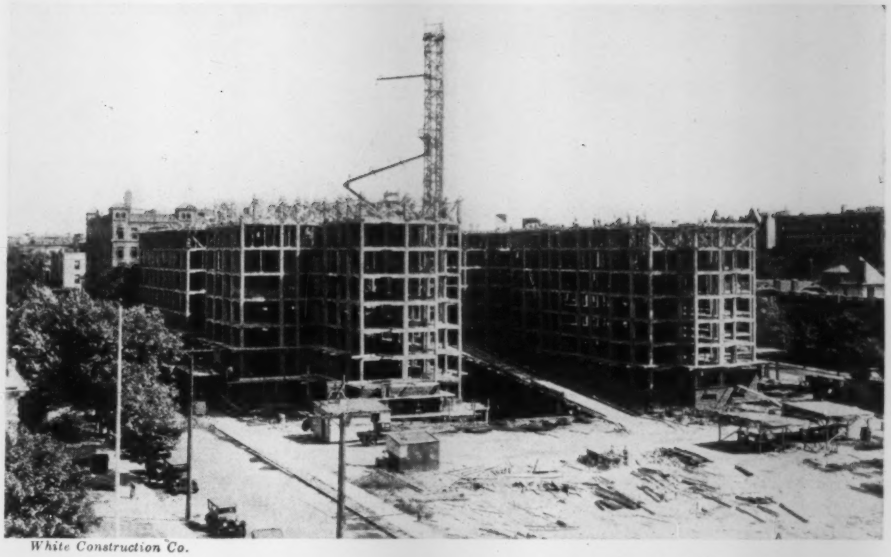
Concrete Contractors—Mixers; bins; measuring equipment; hoists; conveyors; heating devices; saw tables; electric hand saws; vibrators; steel bar cutters and bending machines.

Brick Masons or Plasterers—Hoists; conveyors; mortar mixers; mortar tubs; scaffold materials; stone derricks.

On the other hand, some of the trades require but a comparatively small amount of equipment, as for instance painters, glaziers, and roofers, whose equipment is worth at most a few hundred dollars.

There are three ways in which a contractor can provide the necessary equipment for a job:

1. He may own the tools, machinery, etc., if his financial set-up is such that he can tie up the required capital, maintain a yard, and service the equipment.
2. He may rent the necessary equipment from those whose business it is to own and rent out all types of construction machinery, tools, trucks, etc.
3. He may buy the required equipment at the beginning of a job and sell it when the job is finished for whatever the market will bring.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"Hoisting Equipment Should Be Located so That the Product of the Mass by the Distance to and from the Hoist Through Which the Mass Is Conveyed Manually Is a Minimum"

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Guy Derricks, Assisted by a Crawler, on a Recent Job in New York City

Any one of these alternatives is open to the contractor who uses standard equipment. The second and third, however, are not applicable to the specialist who executes work along certain lines peculiar to himself and involving the use of special equipment. In this case the first alternative is the only possible one.

Even though they may not be the most profitable methods, the contractor who operates under alternative 2 or 3 is in a position to know closely what the plant cost on any given job will be. Not so, however, with the contractor who owns his own equipment—for owning equipment entails a number of fixed charges (such as storage, interest on investment, amortization, and insurance), as well as direct expenses (such as transportation, repairs, and maintenance), which make the proper allocation to a given job uncertain owing to the lack of knowledge as to the number and size of jobs to which these costs will be charged in a given period of time.

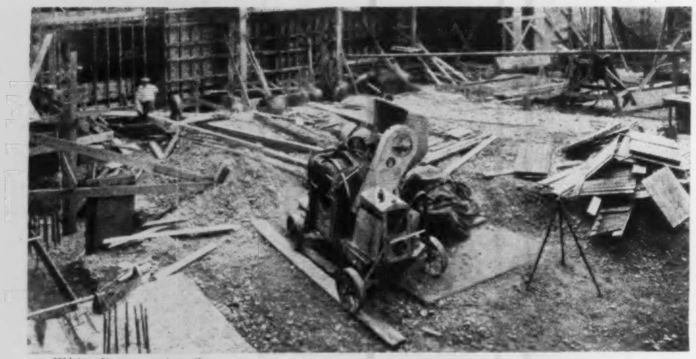
MACHINERY ACCOUNT SHOULD BE SELF-LIQUIDATING

The contractor who invests money in machinery should see that the account is at least self-liquidating by having the machinery at work most of the time and by charging adequate rentals to the jobs on which it is used. In these days of close competition, the contractor who owns his own equipment is prone to undervalue these rentals in estimating work and is likely to find, when the equipment is worn out, that he has no money set aside with which to replace it. If the contractor finds that, to keep his plant account out of the red, he must charge against his jobs a greater sum than he would have to pay to rent the same plant, then he should liquidate his equipment.

The nature or form of the contract which the contractor and owner enter into has a bearing on the plant equipment placed on the job. Whenever the contract is such that the owner is interested in the actual cost of the job, it becomes necessary to stipulate in the contract some definite manner in which the plant cost shall be charged by the contractor and paid for by the owner.

As a rule, the general contractor executes only such work as he cannot sublet at a price lower than his own estimated cost. However, the characteristics of the contractors' organization regulate this to a large extent. The trades which the general contractor usually assumes are brick and tile laying, concrete and reinforced concrete; cement work; carpentry; and of late, plastering. In order to avoid duplication of expense, the general contractor usually installs such hoisting equipment as is required for the entire job and rents it to the subcontractors on an agreed-upon basis.

Broadly speaking, job equipment belongs to one of two classifications, either processing or conveying machines or tools. Under processing machines are included such things as concrete mixing and proportioning plants, concrete vibrators, vacuum equipment for concrete finishing; riveting and welding equipment used in assembling steel work; threading machines used by the



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THE HUMBLE ONE-BAG MIXER, BECAUSE OF TRADE UNION REGULATIONS, MAY SOMETIMES BE MORE ECONOMICAL THAN A LARGER UNIT, EVEN ON BIG JOBS

pipe trades; grinding machinery used in finishing and polishing stone concrete and terrazzo; and drilling equipment. Under conveying equipment are included trucks, power shovels, hoists, elevators, derricks, belt-chains or other types of conveyors, pumps and pipe lines for concrete transportation, and the like.

SELECTION OF MOTIVE POWER

Power generating or transforming machinery is required for both classifications and includes such equipment as steam boilers, gas engines, Diesel engines, air compressors, electric generators or convertors, and electric motors and steam or compressed-air engines. The selection of the motive power on a construction job is dependent upon location, availability of electric power, and the equipment the contractor either owns or can rent. With the increasing sturdiness and dependability of individual gasoline or oil power units, this form of power is becoming more and more popular with contractors because it eliminates all preparatory installation, which is necessary when any other form is used.

The selection of motive power is affected to some extent by the rules of the trade unions in the district where the job is located, relative to the number of supervising mechanics or helpers which they require the contractor to employ to man the necessary equipment. For example, in northern New Jersey, a hoisting operator must be employed on concrete mixers exceeding one-bag capacity, regardless of their motive power or whether they are equipped with a loading skip. As the operator's rate of pay is $16 per day, it is often more economical to make concrete slowly with a one-bag mixer rather than to perform speedier work with a larger mixer but with the added cost of the operator.

In some cities, the wiring of electric hoists for years was done mostly by the hoist rental companies with union electricians who were employed steadily by them and who knew the most economical methods of wiring this temporary equipment. In recent years the electrical unions have required this wiring to be done by electrical workers employed by the electrical contractor on the job. These workmen are rarely as efficient on this type of wiring as were those who made it a specialty, with the consequence that the cost of the initial hook-up has made it more economical on many jobs to use gasoline or Diesel-driven hoists.

In New York City, in hoisting or lowering equipment, such as tanks, boilers, and so forth, where the capstan winch on the delivery truck is used (and operated by the chauffeur), a hoist operator is required to stand by.

Since, as already stated, the use of machinery is essentially a labor-saving device, it is necessary to plan the location and type of conveying equipment so as to effect the greatest saving.

MECHANICAL HORIZONTAL CONVEYORS NOT LIKELY TO BE ECONOMICAL

Mechanical means for conveying materials horizontally have frequently been tried, particularly for handling concrete, such as high gravity counterbalanced chutes, belt conveying units, pipe lines through which the concrete is pumped, or buckets conveyed on cableways. As a rule, these methods prove economical only when the yardage of concrete handled is of sufficient magnitude to absorb the high cost of plant installation and operation. Usually such is not the case in building work, where the average thickness of the concrete is small and frequent shifting of heavy and bulky equipment is necessary.

A very effective piece of equipment for which contractors are constantly finding new uses is the crawler or truck crane. This crane, because of its extreme mobility and self-contained characteristics, can be made to do useful work the minute it reaches the job. The greater reach and capacity which the newer models possess have greatly increased their usefulness. For instance, for the erection of structural steel frames, accessible on all sides and not over about 100 ft in height, these cranes have displaced guy derricks and reduced both the time and cost of erection. They have served also to broaden the use of the "skull cracker" as a tool for wrecking masonry structures.

In laying out the conveying and hoisting plant for a building operation, the aim in general is to reduce the amount of manual handling and conveying to a minimum. Accordingly, the materials should be delivered as near their final location as the job conditions permit, and they should be received in such sequence and so stored as to minimize rehandling. Consistent with these conditions and job requirements, the hoisting equipment should be located so that the product of the mass by the distance to and from the hoist through which the mass is conveyed manually is a minimum.

Processing equipment, strictly speaking, involves all tools used by the workmen. Whereas tools were originally actuated by man power, a great many of them are now power driven. For example, there is the air, electric, or gas driven hand drill which replaced the bull point and sledge; the all-too-well-known air hammer for driving rivets; the power hand saw; the air brush; the rotary grinder and polisher; the power threading machine; and many others too numerous to mention, which are supplanting the hand operated tools and increasing the rate at which a man can do a given type of work. The reduced cost of production which any new labor-saving machine would bring about, however, is offset to a degree by the rulings of labor organizations, which (by agreement with employers or otherwise) successfully put into effect corresponding reductions in the number of work hours per week, limitations on production and increased rates of pay, all designed to protect the potential earning power of the members of their organizations.

From the foregoing, the conclusion may be drawn that the prime purpose of plant layout in building operations, namely, economy, is more or less impaired by job conditions (such as location, plan, size, height), labor requirements, local laws relating to construction work, and the organizational set-up of the contractor. Only by careful planning of the job as a whole, and of the requisite equipment to carry it out, can the maximum benefits inherent in the use of machinery be realized.

Sewerage Works for Flood Protection at Springfield, Mass.

From a Paper Originally Presented Before the Northeast Section

By Frank A. Marston

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Consulting Engineer, Metcalf and Eddy, Boston, Mass.

FLOOD protection for Springfield, Mass., involves not only dikes and walls to keep the Connecticut River within its banks, but also works to prevent the river from entering the city through sewers and to pump out the sewers at times of high river stages. It is with the latter works, construction of which is now about completed, that Mr. Marston's article is primarily concerned. In addition to descriptions of the backwater gates and pumping stations, various interesting hydrologic data are included.

FOR many years, the low-lying North End section of Springfield, Mass., has been protected from flood by a dike along the Connecticut River. This structure was overtopped in November 1927, and was later raised. In March 1936, however, the river rose to a height of 6 ft above the flood crest of 1927. The North End section of the city was again flooded, also the lower part of the business district, and part of the South End, the water covering in all about 800 acres.

The widespread damage and distress caused by this, the greatest flood on record at Springfield, brought about a flood relief project under the direction of the U. S. Engineer Office. This project involved raising and strengthening the North End dike from the northerly city line to North End Bridge, the building of a new dike thence to Clinton Street, and the building of a reinforced-concrete cantilever-type wall from Clinton Street to Cypress Street (Fig. 1).

NEW PROTECTIVE WORKS ALONG RIVER

Land along the river front between the railroad bridge and Memorial Bridge is naturally at a sufficient elevation to be above flood level and needs no further protection. South of Memorial Bridge additional protective works are to be built; plans for these have been prepared by the Engineer Office, and the contract for construction has just been awarded. For the most part these works will consist of low concrete flood walls, earth dikes, and provisions for setting sand bags or stop logs in such openings as are necessary. In addition, a large closed masonry conduit must be built to enclose Mill River for a distance of some 1,200 ft at the outlet end. The new project also includes the building of a concrete flood wall to replace the existing earth dike along the river front in Chicopee and Springfield north of North End Bridge, together with 500 ft of new earth dike near that bridge, making a total length of about 9,000 ft of new protective works.

The first flood relief project was well under way but not completed to the point of affording full protection when the flood of September 1938 occurred following the hurricane. Not only were the new dikes incomplete but the earthwork had not yet consolidated sufficiently to safely withstand the strain of high water, and the dikes were reinforced with sand bags to make them secure. Manhole covers were weighted down and sand bag dams were built to enclose an area over the Washburn Street sewer outlet which, it was feared, might burst as it had not yet been reinforced.

Although the crest of the 1938 flood was nearly 2 ft lower than that of the 1936 flood, it was over 3 ft higher than that of 1927. Because of the lower river level and the protective work accomplished, the area of the city that was flooded was only about 50 per cent of that covered by the previous flood. Even then, 6,000 or more families were evacuated, many industrial establishments were inundated, and the city's highway structures and sewers suffered heavy damage.

DIKES AND WALLS NOT ENOUGH

The solution to the problem of protecting the city of Springfield from damage by flood waters has not been confined to the building of dikes and walls to keep the river within its banks. It has involved, in addition, the construction of works to prevent the river from entering the city through the sewers and the building of works to pump out the sewers at times of high river and avoid flooding within the city by sewage and storm water. Design of these sewerage works has required consideration not only of the heights to which

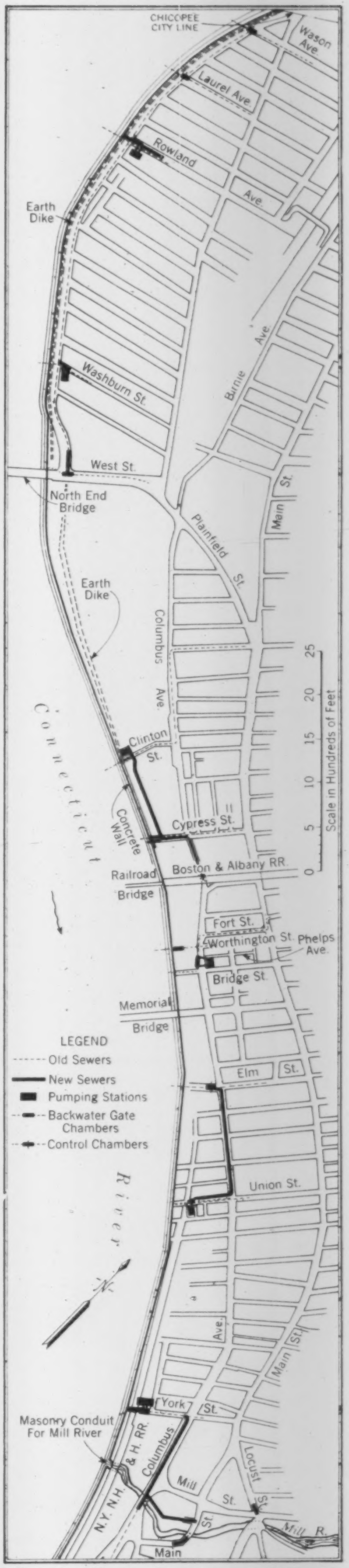

CHICOPEE CITY LINE
Wason Ave
Laurel Ave
Rowland
Ave
Earth Dike
Birnie Ave
Washburn St
West St
North End Bridge
Main St
Plainfield St
Earth Dike
Columbus Ave
Connecticut
Clinton St
Concrete Wall
Cypress St
Railroad Bridge
Boston & Albany RR
Fort St
Worthington St
Phelps Ave
Bridge St
Memorial Bridge
LEGEND
Old Sewers
New Sewers
Pumping Stations
Backwater Gate Chambers
Control Chambers
Elm St
Union St
River
0 5 10 15 20 25
Scale in Hundreds of Feet
Ave
Main St
York St
Masonry Conduit For Mill River
N.Y.N.H. & H. RR
Columbus
Mill St
Locust St
Mill R.
Main
N

Fig. 1. Flood Protection Works, Springfield, Mass.

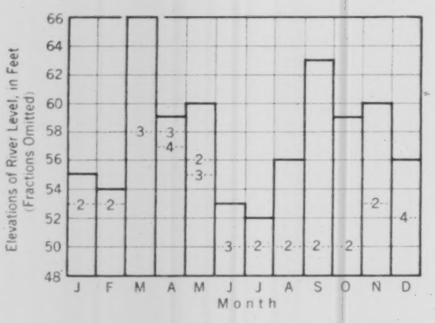


FIG. 2. ELEVATIONS REACHED BY CONNECTICUT RIVER AT SPRINGFIELD, 1854–1938

Full Line Indicates One Occurrence in 85 Years; Dash Lines Indicate Two or More Occurrences, as Shown

flood water in the river will rise, but also of probable rainfall intensities and rates of runoff that will occur simultaneously with given flood-water heights.

Complete records of high water in the Connecticut River at Springfield are available since 1854. Three notable floods have occurred in recent years—in November 1927, in March 1936, and in September 1938. Figure 2 shows the high-water elevations (at 1-ft intervals, fractions omitted) reached during the period 1854 to 1938 for each month. The full line shows elevations reached once in 85 years, while the dash lines indicate those reached twice or more during the period. Floods have been more frequent in the months of March, April, and May, but high water may occur at any time.

CONDITIONS CONTRIBUTING TO MAXIMUM RUNOFF

A high rate of runoff is more likely to occur when the ground is sealed with ice or frost and depressions are filled so as to prevent absorption of water and retardation of runoff. At such times the influence of vegetation in holding back the flow is also at a minimum. While a considerable runoff may result from a warm rain falling upon snow which may be melted and added to the precipitation, this is usually not as effective in producing a high runoff as an intense rain upon an ice-coated or frozen surface.

Winter storms are rarely of high intensity and do not, according to the Springfield record, approach the extreme intensities of cloudburst rains which occur during the warmer portions of the year. The combination of high river elevation, moderately intense rain, and a high runoff coefficient, which will occur during the colder months, is likely to be most significant for estimating the rates at which storm water may have to be pumped into the river when in flood. The heavy rain and high runoff following the hurricane of September 21, 1938, which occurred at a time of high river elevation, was most unusual.

Detailed studies of rainfall intensities occurring during flood stages of the river show that for a river height of El. 55, a rainfall intensity of 0.5 in. per hr for 40 min may be expected during the winter months about once in 13 years. Other estimated frequencies of the simultaneous occurrence of 40-min rainfalls, at various intensities, with high water in the river, during the four winter months (December–March), are shown in Fig. 3. This is based on 44 years of record, 1892–1936. While such relations furnish no direct basis for computing runoff, they are an aid in determining for each district the rainfall, runoff, and pumping capacity for which provision should be made.

In certain sections of Springfield, where the land and basements are at comparatively low elevations, a rise in the river to El. 50, accompanied by heavy rainfall, is sufficient to cause storm water to surcharge the sewers to an undesirable extent. At certain higher stages of the river it is advantageous to pump sewage from the trunk sewers even when there is no surface-water runoff, the extent of the pumping depending upon the height of the river and the location along the river front.

Sewage and storm water now discharge into the Connecticut River through 13 outlets between the Chicopee line on the north and the Mill River on the south (Fig. 1). The four northerly sewer outlets are already served by two pumping stations. When the river rises to El. 49 or higher, a valve is closed by hand in the Laurel Avenue sewer, backwater gates close automatically in the Wason and Rowland Avenue sewers, and the flow in these sewers is discharged through a marginal sewer or directly to the existing Rowland Avenue pumping station (115-mgd capacity), where it is lifted and forced into the river. Backwater gates also close in the Washburn Street sewer and the flow in the sewer passes to the existing Washburn Street pumping station (54-mgd capacity), where it is pumped to the river. Both these pumping stations operated continuously during the 1938 flood.

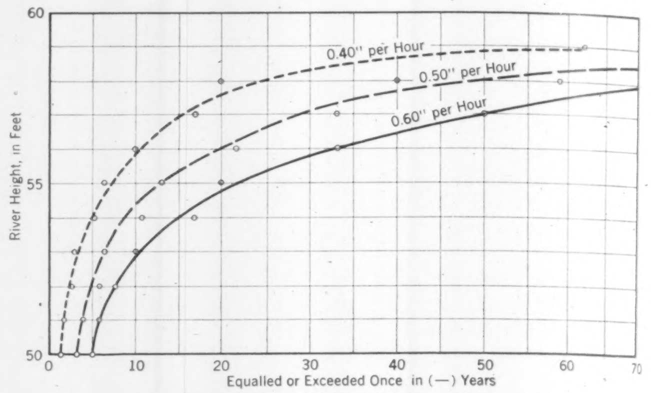


FIG. 3. ESTIMATED FREQUENCIES OF SIMULTANEOUS OCCURRENCES OF 40-MIN RAINFALLS AT INDICATED INTENSITIES AND HIGH WATER IN CONNECTICUT RIVER DURING WINTER MONTHS

MAJOR FEATURES OF THE PROJECT

The project now nearing completion includes four new pumping stations with a total of 14 major pumping units

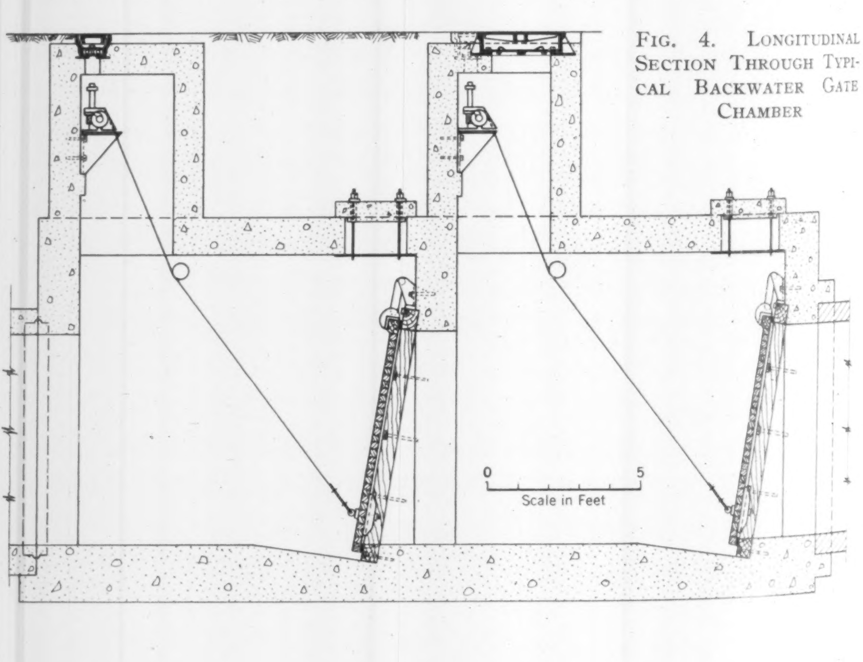


FIG. 4. LONGITUDINAL SECTION THROUGH TYPICAL BACKWATER GATE CHAMBER

together with connecting sewers, backwater gate chambers, and miscellaneous structures, all designed to collect the sewage and storm water from 9 trunk sewers and discharge it into the river during high water. See Fig. 1.

Backwater gates have been installed in the Clinton and Cypress Street sewers, and a connecting sewer of 48-in. reinforced-concrete pipe has been built along the river front to carry sewage and storm water from the Cypress Street sewer to the new pumping station built near the outlet of the Clinton Street sewer, where the combined flow from the two sewers will be pumped into the river. The connecting sewer is laid at such a grade and in such a location that it can later become a part of the Connecticut River intercepting sewer—a facility that will be required when the central sewage treatment plant now under construction goes into use.

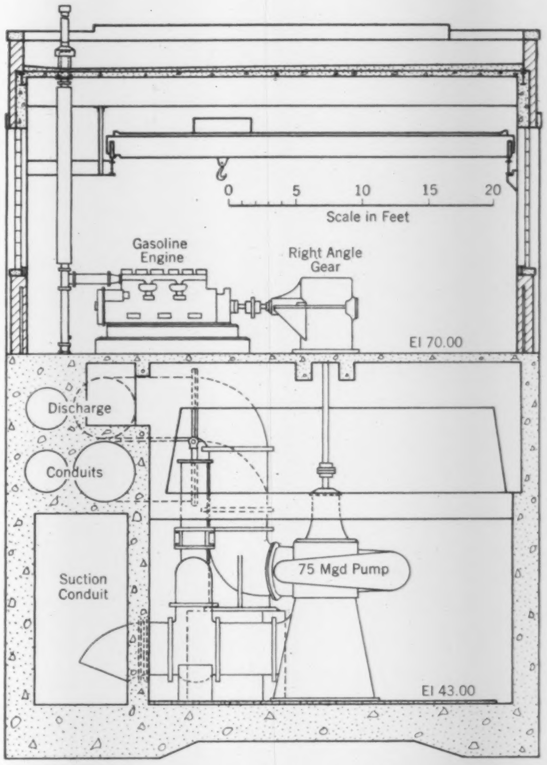


Fig. 6. Typical Cross-Section of Phelps Avenue Pumping Station

Backwater gates have also been installed in the Elm Street sewer and the two Union Street sewers, and a 48-in. connecting sewer has been built from the Elm Street sewer through Columbus Avenue to Union Street, to carry the sewage and storm water during flood periods from Elm Street to the pumping station in Union Street, where the combined flows from all three sewers will be pumped into the river. This connecting sewer, also, will serve ultimately as a part of the Connecticut River intercepter.

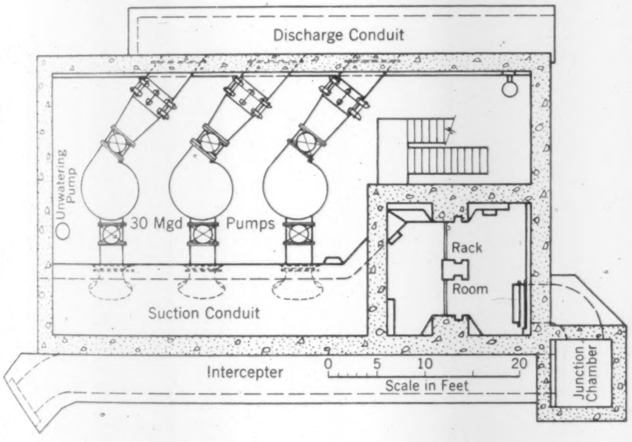


Fig. 5. Plan of Pump Room Floor, Union Street Pumping Station

The Relative Arrangement of Pumps and Motors in This Station Is Similar to That Shown in Fig. 6

The central section of the river front will be served by the Phelps Avenue pumping station, which will handle the combined flow from the two large sewers which normally discharge opposite the foot of Worthington Street and at Bridge Street.

Backwater gates are located in the large sewer in York Street and the fourth pumping station is practically completed near that point.

The general type of double backwater gate structure is illustrated by a typical longitudinal section in Fig. 4. The underground concrete structure encloses two wooden gates held in place by bronze bushed cast-iron hinges. Each gate has a thick rubber gasket to aid in producing watertightness.

The Clinton Street and Union Street pumping stations each have three vertical-shaft mixed-flow centrifugal pumping units, of 30-mgd capacity each, direct-connected through right-angle reduction-gear units to horizontal-shaft 6-cylinder gasoline engines. A pump floor plan of the Union Street Station is shown in Fig. 5.

The Phelps Avenue pumping station is of the same general type, but has four pumping units, two of 30-mgd capacity each, and two of 75-mgd capacity each. A cross-section of this station is shown in Fig. 6. The two large pumping units are of particular interest because of the unusual size and capacity of the right-angle gear units, designed to transmit about 340 hp with a speed reduction from 1,200 rpm to 227 rpm; and because of the large size of the gasoline engines, designed to develop 425 hp at 1,200 rpm.

The York Street pumping station is of a type similar to the Union Street station, but has two pumping units of 30-mgd capacity each and two of 15-mgd capacity each. The two smaller units will be driven by 3-cylinder, vertical, 4-cycle Diesel engines equipped to operate either on fuel oil or sludge digestion gas. A third Diesel engine operated pump is being installed in this station as a part of the sewage treatment plant project.

Electric current will normally be used in all stations for lights and small power requirements, such as the operation of the mechanically cleaned racks. However, each station will be provided with a 15-kw gasoline-engine-driven generator set for standby power in case of failure of the electric power. The original studies were based on the use of electric power to operate the main sewage pumps, but it was later found that very substantial expense would be involved in providing the necessary electric power feeders, and therefore gasoline-engine drives were adopted for all except the two smallest units.

The pumping-station buildings have been constructed with substructures of reinforced concrete and superstructures of steel frame and brick masonry with limestone trimmings. Glass block construction replaces the usual steel sash windows.

ADMINISTRATION OF PROJECT

The sewerage works are being built by the city as a Public Works Administration project, and are estimated to cost $1,158,000. The work is under the direction of the Board of Supervisors of the Department of Streets and Engineering, Cornelius W. Phillips, superintendent. As previously mentioned, the flood protection work along the river is a separate project under the direction of the U. S. Engineer Office.

Portland Cement Stabilization Applied to Foundation Construction

From an Address Before the San Francisco Section

By F. B. Butler

Captain, Corps of Engineers, U. S. Army; Military Assistant,
U. S. Engineer Office, San Francisco, Calif.

DEVELOPMENT of plans for the construction of a heavy and complicated structure in the San Francisco District of the U. S. Engineer Department produced an interesting foundation problem. The difficulty was due to the fact that an existing supporting block for an exceedingly heavy but meticulously leveled mechanism could not be disturbed in placing the foundation for the new structure. Incidentally, the dead load to be carried by the new foundation amounted to over 14,000 tons, plus an impact of tremendous but indeterminate amount.

The material in which work was to be performed was an extremely fine dune sand which, however, graded quite uniformly from a minute clay content to sand grains of 2 mm in diameter. The foundation block for the mechanism already in place (Fig. 1) extended 18 ft below grade, and the area surrounding it had been backfilled with the native material, tamped under tractor and roller action. Footings placed directly on this material, even if spread to the limits of the available area, would have produced excessive settlement. If the footings for the new structure (which, incidentally, was not concentric with the mechanism base) were founded at an elevation above the bottom of the block, it was feared that the sand, in compacting, might produce movement which would tend to destroy the perfectly uniform level of the rotating mechanism. Driving of piles in the sand under these conditions presented similar difficulties.

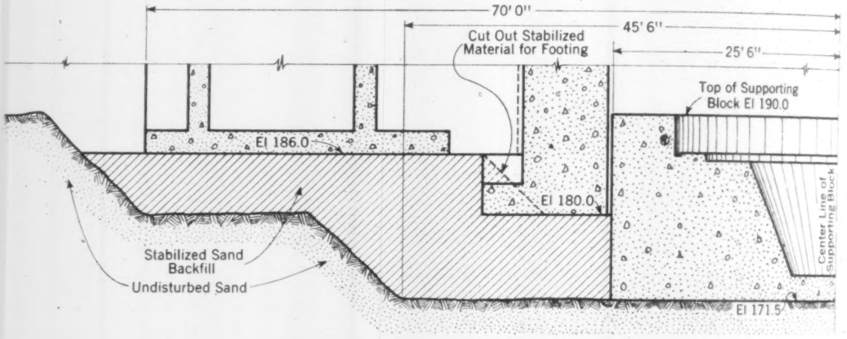
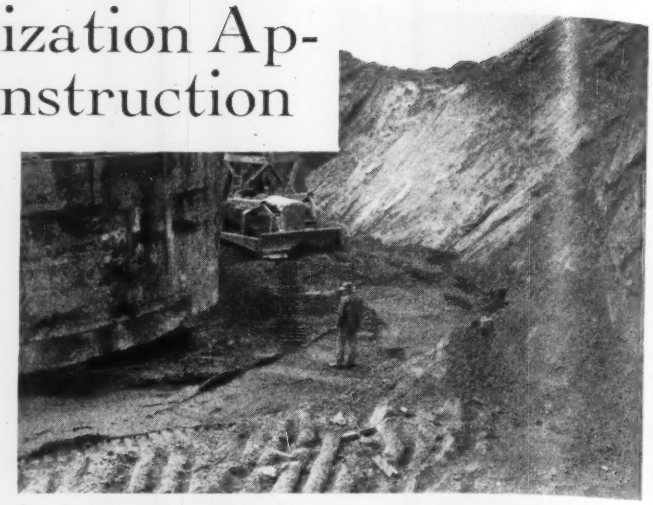

70' 0"
45' 6"
25' 6"
Cut Out Stabilized Material for Footing
Top of Supporting Block El 190.0
El 186.0
El 180.0
El 171.5
Stabilized Sand Backfill
Undisturbed Sand
Center Line of Supporting Block

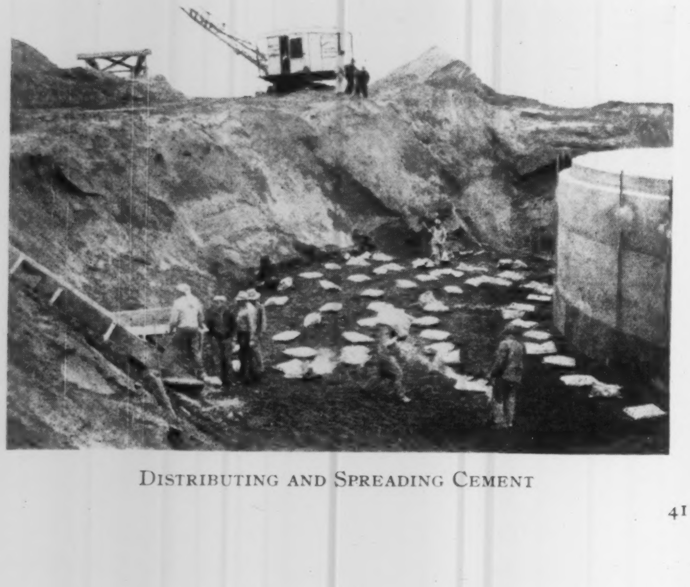
Fig. 1. Typical Radial Section of Foundations

The "Supporting Block," in Place at Beginning of Operations, Is Circular. Dimensions of Backfill Area and Locations of Footings Vary from Point to Point About the Circle

Consideration was therefore given to two possible means of developing a sufficiently strong and compact mat to support the footing loads by stabilizing the native material surrounding the foundation block already constructed. The first was the Jorgensen (chemical) method; the second, stabilization with portland cement.



Leveling Off a Layer of Backfill



Distributing and Spreading Cement

The former method possessed many advantages, of which the principal one was that the surrounding mass could be solidified without excavating around the existing foundation. The estimated cost, however, was very high. Careful study indicated that the foundation block could be uncovered with a better than reasonable factor of safety, thus permitting complete excavation and subsequent stabilization of the backfilled mass with portland cement. Since the latter procedure had a distinct advantage over the use of chemicals in the matter of cost, it was determined to do the work along lines that had been developed recently for soil stabilization in highway construction.

Laboratory analysis of the sand developed the fact that sufficient strength would be developed with an 8 per cent admixture of portland cement. As a factor of safety to compensate for field manipulation, an admixture of 10 per cent was decided upon.

The next step was the determination of the elevation which should constitute the plane of division between the stabilized backfill and the reinforced concrete footings of the new structure (Fig. 1). Based on cost estimates, it developed that 8 ft of backfill was the economic point of division. The excavation around the block was done by dragline and presented no difficulties. Despite the fact that computations for the supporting power of the undisturbed sand indicated reasonable safety, hourly levels were taken on the foundation block in order to detect immediately any indication of movement. Parenthetically, none developed, and a test of the rotating mechanism through the full circle showed deviations of not more than $^1/_2$ sec from horizontal.

METHOD FOLLOWED IN PLACING BACKFILL

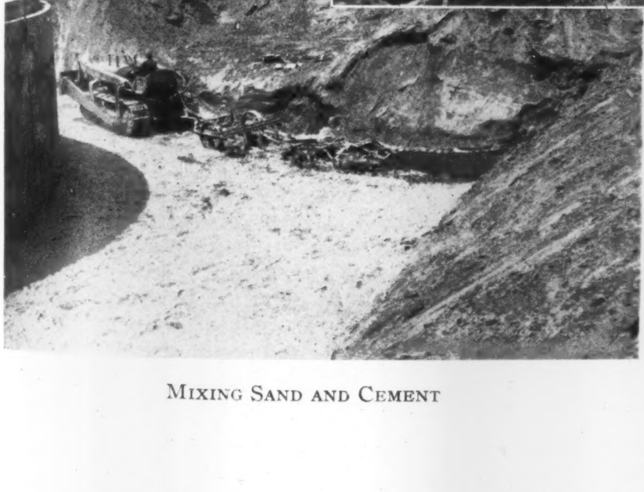
In placing the backfill, the material was worked in 6-in. layers. Material was cast into the pit with a clamshell bucket and leveled off to the required thickness with a bulldozer. The 10 per cent portland cement content was then distributed uniformly over the area. Distribution was by hand, sacks being emptied in precise areas of a checkerboard pattern. As no reasonable machine method of distribution could be developed, this operation was the slowest and most costly part of the whole process. After the cement was spread, the sand and cement were mixed with a harrow and disc plow drawn in tandem by a tractor. It took eight passes of the mixing apparatus to effect the desired mixing.

Compacting—The Last Step in the Cycle

Next, the material was sprinkled to obtain the required moisture content. Specifications called for the use of a meter in this operation, but sprinkling "by eye" quickly proved to be more satisfactory than this refinement. The moisture content for maximum compaction was 12 per cent. Following the wetting, the layer was tamped with a tractor-drawn sheepsfoot roller. The weight of 1 cu ft of sand with a 10 per cent cement admixture under laboratory conditions of compaction was 120 lb. Samples taken regularly during the work show that field operations as described here produced a minimum weight of rolled material of 115 lb per cu ft.

As soon as the desired compaction was obtained, the cycle was repeated—backfilling, spreading, mixing, wetting, rolling. Two 8-hour shifts were worked. As a curing measure, the final operation at the termination of a day's work was the spreading of a layer of sand. It was feared that the successive operations might have a deleterious effect upon layers in the process of setting, but results proved these fears to be groundless. Though no cores were taken, observations were made where it became necessary to cut into the compacted material, and the mass was found to be uniformly hard and compact. The whole mass apparently set into a remarkably homogeneous block.

Wetting; Mixing Approaching Completion



Mixing Sand and Cement

Naturally, with the mixing methods that were employed, considerable variation would be expected in the compressive strength of the material. Test cylinders taken from each layer as it was mixed, showed 28-day strengths varying from a minimum of 250 lb per sq in. to a maximum of over 800. The average of 13 cylinders at 7 days was 275 lb; the average of 6 cylinders at 14 days, 392 lb; and the average of 15 cylinders at 28 days, 456 lb. One bearing test was made on the stabilized material, and with a loading of 18 tons per sq ft over an area of 3 sq ft the settlement was 0.0011 ft. The foundation design called for a loading of 4 tons per sq ft.

The estimated cost of the stabilized material was \$2.62 per cu yd. The actual cost on 4,000 cu yd in place was \$2.54. The only comparison that can be drawn on costs for this type of work is from reports on highway construction, where working conditions are naturally much more favorable. It is of course much easier, cheaper, and simpler to do this work on long straight lines than to follow continuously around in a circle, where changes must be made in equipment for each successive step. On a roadway job completed in this vicinity a year and a half ago, where the width of road was 20 ft and the stabilized course was 6 in. deep, the cost per square yard was \$0.3675. Translating this to a cubic yard basis, we get approximately \$2.20. It is believed that these figures compare favorably and indicate that in any foundation work of this type costs of from \$2.50 to \$2.60 per cu yd could be anticipated.

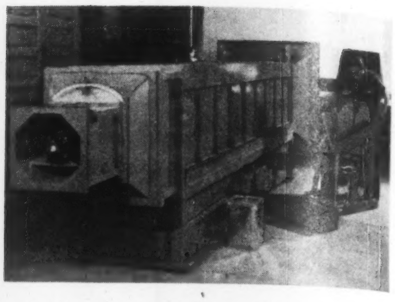
In conclusion, mention should be made of the cooperation and assistance of R. D. Rader, M. Am. Soc. C.E., who served as consultant both on investigation and on construction.

Wind-Tunnel Classifier for Sand and Silt

Inexpensive Apparatus Sorts Granular Materials for Laboratory Use

By George H. Otto
and Hunter Rouse, Assoc. M. Am. Soc. C.E.

Respectively Assistant Geologist and Associate Hydraulic Engineer, Cooperative Laboratory, U. S. Soil Conservation Service, California Institute of Technology, Pasadena, Calif.



THE WIND-TUNNEL CLASSIFIER
Operator Is Transferring Separates from Pans to Storage Containers

METHODS of sorting granular material according to particle size have long claimed the interest of a number of professions. Sieves are widely used as a means of laboratory analysis, and on a large scale are well adapted to commercial sizing of gravel and crushed stone. However, sieving becomes less satisfactory for quantity separation as the material decreases in size, and it is particularly difficult to obtain well sorted separates with sieves finer than 200 mesh; furthermore, large variations in the shape or density of particles may cause undesirable complications. These difficulties are largely overcome in hydraulic separation, either air or water being used as the distributing medium. Such methods have reached their highest development in the abrasive and mining industries, but the various patented devices developed by them are generally designed for specific separations on a commercial scale.

The increasing need for a simple, dependable, and inexpensive classifier has become particularly apparent in the sediment-research laboratory, where a wide assortment of sand and silt separates is required in sufficient quantity for experimental investigation. As has been demonstrated at the Pasadena laboratory of the Soil Conservation Service, U. S. Department of Agriculture, artificial mixtures of any desired type can readily be prepared from a series of well-sorted separates differing in average diameter by a small increment. Since the material required by this laboratory includes sizes finer than 200 mesh, and since it is used exclusively in hydraulic experiments, a method of sorting based on settling velocities has been developed, with equipment constructed at low cost in the laboratory shop.

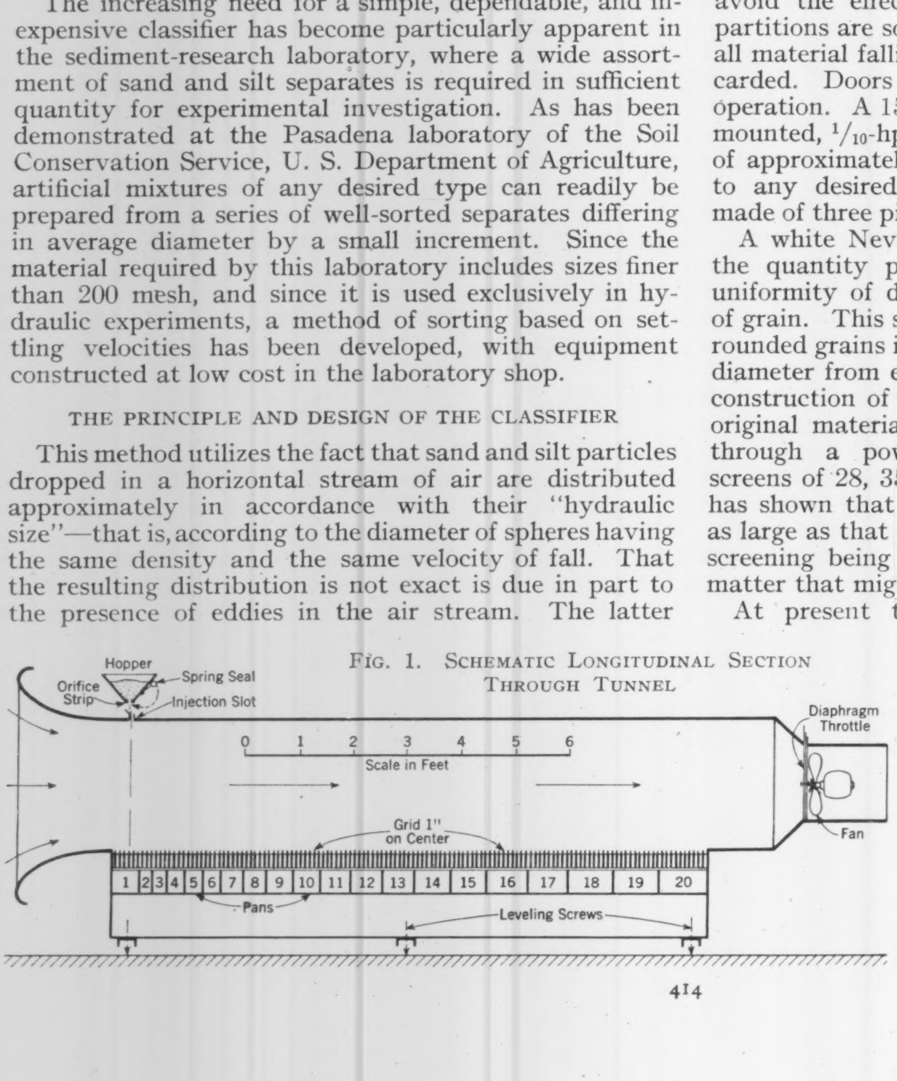
THE PRINCIPLE AND DESIGN OF THE CLASSIFIER

This method utilizes the fact that sand and silt particles dropped in a horizontal stream of air are distributed approximately in accordance with their "hydraulic size"—that is, according to the diameter of spheres having the same density and the same velocity of fall. That the resulting distribution is not exact is due in part to the presence of eddies in the air stream. The latter influence has been reduced to a minimum through the use of a tunnel having a carefully rounded bell entrance, a fan at the downstream end drawing a steady flow of air through the structure (Fig. 1). As shown in Fig. 2, the tunnel is rectangular in section, the inner surfaces of the sides and top being smoothly joined and enameled. A gravity-feed hopper, located near the beginning of parallel flow, discharges the sediment in a thin, uniform sheet extending nearly across the section. The flow from the hopper can be started or stopped abruptly by means of an external spring seal, while interchangeable orifice strips permit regulation of the rate of feed between the limits of 60 and 100 lb per hr. The entire bottom of the tunnel consists of a grid so shaped and finished as to prevent the accumulation of sediment on the upper edges. Grains falling to the floor therefore pass at once through the grid to the collecting pans. In order to avoid the effect of wall influence on the separation, partitions are so located in the grid and in the pans that all material falling within 3 in. of either wall can be discarded. Doors at pan level seal the tunnel sides during operation. A 15-in. duct fan, driven by a sealed, rubber-mounted, $^1/_{10}$-hp motor, provides a maximum air velocity of approximately $2^1/_2$ ft per sec. This can be reduced to any desired magnitude by a diaphragm throttle, made of three pivoted sheet-metal sections.

A white Nevada foundry sand has been selected for the quantity production of separates, because of its uniformity of density, mineral composition, and shape of grain. This sand contains 99 per cent silica, has well-rounded grains in the coarser sizes, and varies in nominal diameter from essentially 0.02 to 0.6 mm. Prior to the construction of the wind-tunnel classifier, 5 tons of the original material had been partially sorted by passing through a power-operated sizing device containing screens of 28, 35, and 48 mesh. Subsequent experience has shown that the present classifier will sort material as large as that passing the 28-mesh screen—preliminary screening being necessary, of course, to remove foreign matter that might clog the hopper orifices.

At present the routine procedure of classification is as follows: Thoroughly air-dried, screened material is first passed through the tunnel with the throttle nearly closed, in order to separate the silt and dust from the sand. The coarse material collects directly beneath the feed slot, the fines being sufficiently well distributed to permit choice of separates from all but the first few pans. (Most of the dust settles outside the machine; although the amount is very small, its presence in the air warrants the use of a respirator by the operator

FIG. 1. SCHEMATIC LONGITUDINAL SECTION THROUGH TUNNEL



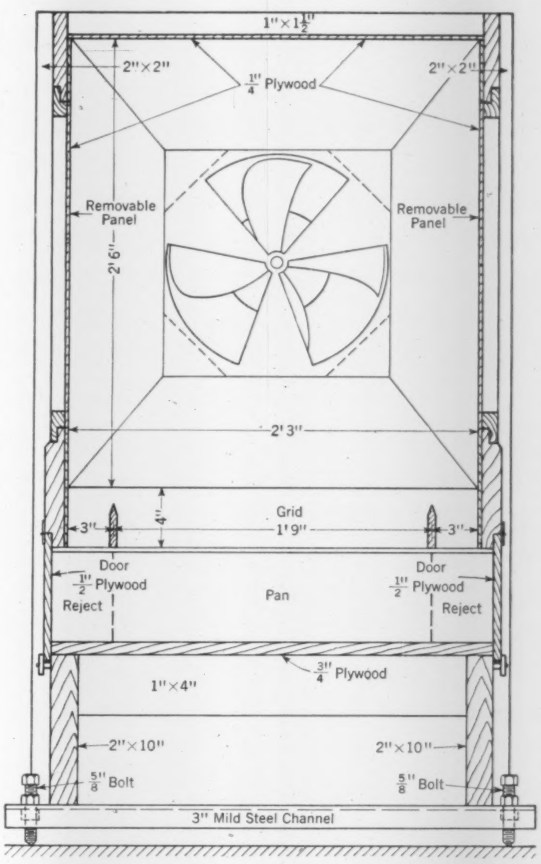


FIG. 2. CROSS-SECTIONAL DETAILS OF TUNNEL

to avoid the danger of silicosis.) The equipment is next cleaned, and the contents of the first few pans are mixed and rerun with the diaphragm set at maximum opening. Fairly sharp breaks in the amount of sand collected in the pans will now be found near both ends of the tunnel; the position of the upstream break depends upon the screen used in cleaning the original material, and that of the downstream break upon the number of separates removed after the run with the throttle nearly closed. The contents of all pans before the first break and beyond the second are now rejected, separates being obtained from the remaining pans. Material caught in the wall sections is added to the other rejected material, which may be mixed and passed again through the classifier when a sufficient quantity has accumulated. In this manner 25 or more separate grades are obtained, each differing in average size but possessing almost the same degree of sorting as the next finer or coarser grade. The separates are stored in 5-gal cans, samples for control analysis being taken from each can by means of a Jones sample splitter.

Although the wind-tunnel method of classification yields hydraulic rather than true geometric separations, the shape and density of the sediment in use by the laboratory are such that sieve analyses furnish more than a qualitative measure of the degree of sorting obtained. In Fig. 3, for instance, will be found a typical set of cumulative distribution curves for the final separation with open throttle; these correspond to the usual "per cent finer" curves, but are plotted on logarithmic probability paper in order to yield a linear graph for the logarithmic form of the normal error law. It will be seen that the material caught in each pan has an essentially normal distribution, except for a very small percentage of dust tails, under which circumstances the median and the geometric mean diameters for every separate coincide at the 50 per cent line. Since a vertical line represents perfect sorting, the deviation of each curve from the vertical is a measure of the size dispersion about the geometric mean. The dispersion will be seen to increase slightly with distance from the point of feed, owing in part to an increase in turbulence along the tunnel boundaries and in part to the fact that the smaller sizes are more angular than the larger and hence show greater effect of shape in hydraulic versus sieve classification. A plot of the geometric mean diameter as a function of the horizontal distance from the feed slot to the middle of each pan (Fig. 4) is evidence of the smooth progression in size secured by the classifier.

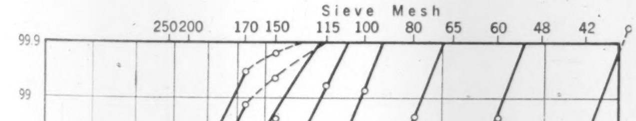


FIG. 3. ANALYSES OF MATERIAL CAUGHT IN PANS 3, 5, . . . 15, 17 DURING FINAL SEPARATION

For precise results, the room in which the work is performed should be at least twice as long and several times as wide as the tunnel itself, to permit quiet circulation of air. Drafts, needless to say, must be avoided. Best performance will result if the tunnel is placed symmetrically in the room, with as much free space as possible around the bell entrance. The temperature should be reasonably constant for all runs, although variation in temperature will affect only the very fine sand and silt sizes; indeed, test runs with a 35 F difference in temperature showed no measurable displacement of material coarser than 0.1 mm, while in the finer range the greatest change in mean diameter in any one pan was about 5 per cent, or some four times the probable error of mechanical analysis. Control analyses of the material caught in the various pans over a six-month period of operation indicate that with ordinary care the variation in mean diameter and degree of sorting will be no greater than two or three times the probable error of analysis.

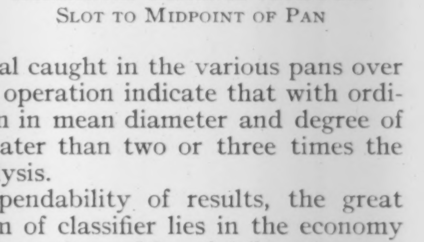


FIG. 4. MEAN GRAIN DIAMETER AGAINST HORIZONTAL DISTANCE FROM FEED SLOT TO MIDPOINT OF PAN

Aside from the dependability of results, the great advantage of this form of classifier lies in the economy of construction and operation. Material for the unit now in use cost approximately $50, and it has been operated by one laborer for the past year. Needless to say, this design can readily be adapted to other requirements by modifying dimensions or fan capacity.

How Providence Did It

"Will of People" Chief Factor in Bringing National Traffic Safety Award to Rhode Island City

By RALPH W. EATON
TRAFFIC ENGINEER, CITY OF PROVIDENCE, R.I.

THE City of Providence, R.I., was the winner of the Grand Award among all American cities in the National Traffic Safety Contest for 1938 conducted by the National Safety Council. The announcement was made March 30, 1939.

In achieving this distinction, Providence had to overcome very keen competition, for the great majority of cities in the 1938 contest showed a radical reduction in motor-vehicle accidents over previous years. In Providence, the number of motor-vehicle fatalities was only 16—a rate of 6.3 per hundred thousand of population. This was the lowest rate established in any city of 250,000 population or greater, in any recent year. It was nearly 16 per cent lower than our best previous record, made in 1934, and compares with an average rate of over 15 per hundred thousand for all cities in the contest having over a quarter of a million population. Accidents involving personal injury (not fatalities) were reduced by some 47 per cent from the previous year, and from the average of five previous years (Fig. 1).

ENTERING
PROVIDENCE
THE SAFE CITY
TAKE IT EASY
STRICT ENFORCEMENT
PROVIDENCE
25
SPEED LIMIT

In recognition of the reduced accident hazards in the Providence area, a reduction of 20 per cent in insurance rates for the standard automobile policy was announced early in 1939. Activity in the accident wards of our hospitals has dropped off notably, and the "tow-car" business is in a severe depression.

On every hand in Providence there is evidence of a new attitude among the various users of the highways. I doubt that any stranger could operate an automobile here for a day without sensing this condition. If I rightly judge this attitude, it means something very important, because without the will of the people behind it, our safety effort could not have achieved its present measure of success. A recent Gallup poll seems to indicate that among all classes of our people there exists a determination to do something about the problem of automobile safety. If this is so, a heavy duty rests upon public officials and others interested in the problem to give leadership to this popular desire, and to offer means whereby it can become effective.

For years Providence people had been to a considerable degree safety conscious, and had been proud of the standing of their city in traffic safety. The city had won national recognition in 1933, 1934, and 1935 (as winner among the cities of its population group in the National Traffic Safety contests), but in 1936 the toll of automobile fatalities increased materially, and in the first 11 months of 1937 more people were killed than in any other year in recent times. Our leadership in this respect was lost, and our people were wondering what—if anything—was going to be done about it. Late in November 1937, a program was determined upon and was announced by the Bureau of Police and Fire. Prior to this announcement, the problem was fully discussed with the local newspapers, who promised their full cooperation—a promise that has been generously carried out. The Governor's Committee on Street and Highway Safety was strongly behind the project, as was also the Automobile Club of Rhode Island.

Attention should be called to three things which appear to have been vital to the success of the drive:

1. The Superintendent of Police placed the leadership of the campaign in the hands of a deputy superintendent—in other words a man who outranked any captain.
2. The campaign was announced to last six months to combat any idea that it was to be of brief duration. We were all rather afraid of the word "campaign," as indicating an effort that would have an early end. As a matter of fact, after the first few months, no one had any idea of allowing any part of the activity to be relaxed even at the end of six months.
3. Arrangements were made to let the public know frequently of the saving effected in accidents and injuries, which was substantial from the beginning.

I cannot overemphasize the importance of the cooperation given by the newspapers. Without it we could not have got anything like the results we did get. My clipping file shows, for the year 1938, a total of 13,091 column inches, divided among 821 articles—about 81 full newspaper pages. Of course no hard-headed newspaper man would devote this amount of space to anything unless the public was interested, but the thing works in a circle once it gets started. Also, the work done by our three radio stations should not be overlooked, as they put out a great deal of publicity throughout the year, and are still doing so.

The Superintendent of Police and his deputy prepared and sent out a large number of letters—to the pastors of all churches, to civic and other clubs and organizations, and one addressed to householders, which was distributed to more than 60,133 homes. A courtesy card, explaining the campaign and requesting cooperation, was handed to great numbers of drivers. Many talks were given before various organizations and over the radio. The "school squad" swung into action, and the children were asked to take the message home.

WIDESPREAD SUPPORT FOR CAMPAIGN

Evidences of support were widespread. Many responses were received, and cooperation was urged in great numbers of churches, clubs, and other organizations. Soon it was possible to give out preliminary figures showing the reduction in injuries, and these had a remarkably good effect in convincing the public that the campaign was worth while and should be supported. The final figure for the month of December 1937 showed a reduction of more than 44 per cent in the number of persons injured.

The slogan was "Not over 20–25 miles-per hour in the city," which the public promptly shortened to "Not over

25." The reception given to this limit was on the whole excellent. There were some, of course, who said it was too slow for certain streets, it required much longer to get from place to place, and it increased congestion. We could devise no good way to prove that speeds above the limit do not decrease congestion (though we know it), but we believed it was possible to prove that the time saved by attempts to speed was insignificant. To show this, we staged a demonstration witnessed by representatives of the press and others. I made certain trips across the city, keeping strictly within the 25-mile limit, and otherwise obeying all safety rules and traffic regulations. Each of these trips was duplicated by the manager of the Automobile Club, with a driver who disregarded the speed limit, and went as fast as he felt was consistent with safety. There was no racing and nothing spectacular about his driving, but he tried to go like the fast, "snappy," clever driver. The results showed that he saved only 74 seconds in going clear across the city in one direction, and 97 seconds in another. The public, it seemed, was much interested in these tests, which pretty well exploded the idea that careful driving led to great loss of time. We have heard little complaint in regard to speed limits since the test was made.

RECORD PERIOD PASSED WITHOUT A FATALITY

Another "stunt" that appeared to arouse great public interest should be described. Toward the end of March 1938 we announced that if we attained the 50th day without a traffic fatality, every police car would be decorated with the number "50," and foot-traffic officers would wear arm bands bearing that number. Thus for a few days before the celebration there was an element of suspense, and when the decorations appeared there was an element of mystery for those who did not know what the number meant. As a publicity stunt the thing was a "natural," and we had everybody talking. A local paper started carrying a caption daily showing the number of days to date, and it seemed that everybody could tell "what day it was." It went so well that we announced another celebration if we attained the 60th day, which we did. Later we announced a special celebration if we attained our 100th day. On this day a great banner was spread across the front of City Hall, large posters were carried on trolley-cars, as well as the usual tags on police cars and arm bands on officers. All these signs carried simply the number "100." The Mayor and others spoke over a national radio hook-up, and Sidney J. Williams, M. Am. Soc. C.E., director of the Public Safety Division, National Safety Council, announced that the record was, so far as he knew, unequaled. On June 12, our 125th day, a boy who had run his bicycle into an automobile on May 29 died, so our record went back to 111 days.

We all had been somewhat afraid of overemphasis on this matter of "days without a fatality" and of the reaction when the period should end. However, the percentage of reduction in injuries in July was nearly as high as in any month of the campaign. I for one believe that this publicity device actually saved lives and injuries. I don't know how often I heard the remark, "I'd hate to be the one to break that record."

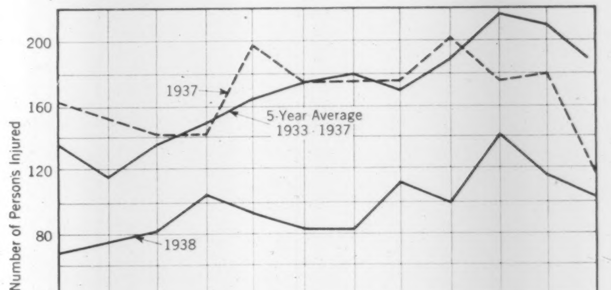


Fig. 1. The Providence Traffic Injury Record, 1933–1938

Although public interest appeared to be fully sustained as the months passed, those concerned with the campaign were watchful for signs of a let-up. Various schemes were worked out to keep up the general interest, and some were very successful. It must not be assumed that the speed restriction was the only element emphasized. Other safety practices were also of great importance. Figures from the regular monthly routine observations made by this office showed such things as 94.3 per cent obedience to "stop" signs, as well as less than 1 per cent of cars observed operating at speeds of over 30 miles per hour. These percentages are still being obtained in 1939. While it is probable that public enthusiasm reached its peak when the city went for 111 days without a fatality, it is not to be overlooked that already this year we have gone two hours short of 99 days, a period which ended June 11. As of June 22, 1939, the latest date of available record, the number of fatalities for the calendar year stands at 5, whereas in 1938 it stood at 6 on that date.

One can scarcely attribute the reduction in traffic accidents in Providence to any innovation in the line of education, enforcement, or engineering. If, for example, we had in the past had very poor accident investigation and had installed an accident investigation squad with a special car carrying such equipment as camera, tapelines, and portable typewriter, then Providence would have been listed among the cities that had made a great record because of this. The same conclusion would have been drawn if we had installed an "enforcement budget" and convicted 10 people for each personal injury accident, if we had hired a traffic engineer and he had made a new traffic survey and installed a lot of new channelizing islands, or if we had started a school squad, or inaugurated our system of patrols on main arteries, or put into effect any one of a number of other activities. As a matter of fact we had been doing these things for years; we simply tightened up and redoubled our efforts during 1938. Perhaps it could be said that we were "cashing in" on years of effort. Perhaps the public is changing its whole viewpoint about this subject of accident prevention.

My belief is that the largest factor in producing the result was the will of the people. There was a general feeling that it was "the thing to do" to conform to what was being asked—not because one might be arrested otherwise, but because the goal was so well worth while.

If I were to summarize the most important elements contributing to the success we achieved, I should mention the following, without regard to their order: Our people were ready for and receptive to some sort of special effort late in 1937; the local press rendered most generous and intelligent support from the first; the public recognized and desired to strongly support a new attitude on the part of the public authorities; and there was excellent staff work by the police.

How long will this improvement last? Nobody knows. However, more and more of late people have said to me that it is getting to be a habit to drive more safely and carefully, and that this is why there seems to be no abatement in the saving of lives and injuries. Such an idea may be a little too optimistic, but it certainly contains a germ of truth.

Welded Shear Reinforcing for Concrete Beams

A Substitute for Wire-Tied Vertical Stirrups Offers Possibilities

By Dewey M. McCain

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The discontinuities in the reinforcing system of a concrete beam can be eliminated, says Professor McCain, by substituting diagonal bars, welded to top and bottom steel, for the conventional wire-tied vertical stirrups. The welded reinforcement strengthens the beam in shear, and incidentally gives promise of being somewhat cheaper than the wire-tied type. Moreover, strain-gage readings show that the stress in welded shear steel can be predicted with reasonable accuracy, whereas the calculated stress in tied vertical stirrups has no definite relation to the actual stress. The accompanying article discusses theoretical and practical points involved in the use of welded bars and indicates some of their advantages over loose stirrups. Records of fabrication costs, obtained from timed operations, are included and compared with the estimates of experienced contractors and fabricators.

Vertical stirrups as shear reinforcing probably constitute the most unsatisfactory element in the design of concrete structures. Since its inception, concrete design has developed rapidly, and intensive and well-directed research has resulted in a type of design which is, in general, very creditable. However, it is the almost universal opinion that loose stirrups are not satisfactory, and that they are used solely for lack of something better. That they have prevented failure of concrete beams is general knowledge. But they have done this because of the ridiculously low unit shearing stress allowed in the concrete by standard specifications.

Certain major objections to loose vertical stirrups are:

1. The absence of continuity in the reinforcing system. (The vertical bars are not connected to the tension bars or to each other, and cannot be placed in the direction of the forces they are designed to resist.)
2. Inability of the stirrups to take stress until the beam has cracked.
3. The guesswork involved in their design.

All these objections, together with most of the practical difficulties encountered in tying and placing shear steel, can be eliminated by placing the shear bars at right angles to the cracks and by joining the various elements of the steel together. This joining of members is the sine qua non of all other structural design, and is implied in the "truss analogy" used to develop the theory of design of stirrups. Of course, much emphasis is placed on bending the stirrups around the top and bottom steel—but does this insure "truss action?" The idea might be carried to its logical extreme by specifying that the verticals of a Warren truss be "hooked around" the top and bottom chords.

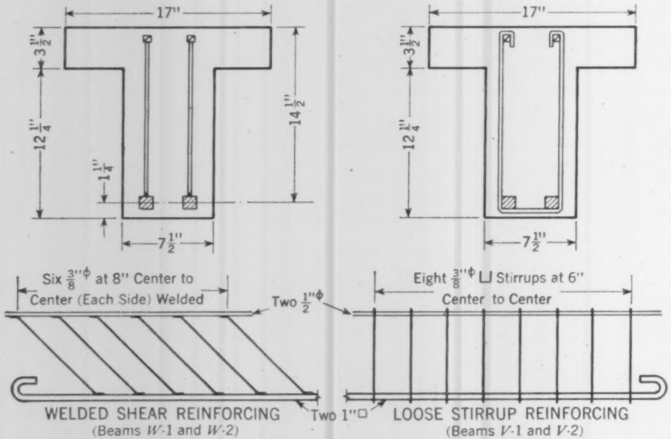


Fig. 1. Details of Typical Test Beams

The research described here has extended over a period of 10 years. In 1929 and 1930 attention was centered on determining the practical difficulties involved. The units welded together at that time withstood the rough handling required in shipping and placing, and our experience in building them with an untrained crew indicated that shop fabrication would be simple. In 1931 and 1932 we tested four beams, in which various arrangements of welded units were used to learn proper details of design and to accumulate other preliminary data. In 1933 detailed information was obtained on four full-sized beams tested to failure. Strain-gage readings were taken on the welded diagonal bars, on vertical stirrps in similar beams, and on the horizontal bars, as well as on the tops of two beams to locate the neutral axis. An average of about 30 readings was made on each bar as the load was increased by increments. Deflections were measured.

Since that time 8 additional beams have been broken to clarify questions arising during the former tests. In practically all these tests, comparisons of the two types of shear reinforcing were obtained by testing beams in pairs which were identical except for shear reinforcing. The shear reinforcing was made equal in horizontal cross-section for each pair of beams, the welded bars—placed at 45 deg—being 1.414 times as far apart as the vertical stirrups. The accompanying photographs and Fig. 1, show typical design details. The results of the tests are indicated in Figs. 2–6, and are discussed in the following paragraphs.

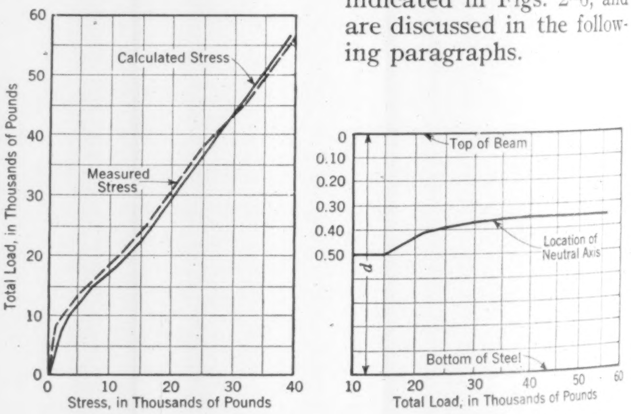
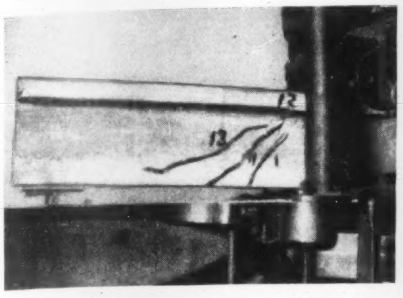


Fig. 2. Comparison of Measured and Calculated Stress in Tension Steel, and Location of Neutral Axis

Calculated Stresses Were Based on Values of *n* Determined by the Observed Location of Neutral Axis

All strain-gage readings were taken twice by an experienced operator and checked. Still, some proof of the reliability of the shear curves was desired. To this end the graphs of Fig. 2 were plotted, showing the measured location of the neutral axis of the beam and the calculated and measured stresses in the tension steel at midspan. There was a very close agreement between calculated and measured stresses, and the position of the neutral axis varied as anticipated.

In Figs. 3 and 4 the position of the shear steel relative to the loads and reactions is shown, together with the load-stress curves on which much of this discussion is based. All these curves are for gage points located outside the influence of the concentrations, except curve 2-5-6 of beam V-1 and curve 2-5 of beam W-1, which are shown in the lower left corner of Fig. 3. The exceptions were included to illustrate the behavior of shear steel—especially vertical shear steel—directly, or nearly, under a load. As further examples of this behavior, gage points 2, 3, 6, and 7 of beam V-2 (see Fig. 4 for location) were alternately in compression and tension throughout the test, and in another test of a similar beam a compressive stress of about 20,000 lb per sq in. was recorded in a vertical stirrup directly under the applied load. For the remainder of this discussion, since the object is to find the relative shear resistance of two systems, only those gage points on bars located about midway between load and reaction will be considered.



A Compression Failure in a Beam with Welded Reinforcement

The strain gage measurements indicated that the average stress in the vertical stirrups was practically zero until the concrete cracked. Further, regardless of the amount of load, if no crack was visible across a vertical stirrup the stress in that stirrup remained zero, or thereabout, until the beam failed. The welded bars were stressed as soon as the load was applied. Although this stress was small compared to the stress after cracking began, it is probably this ability to take stress as soon as load is applied that accounts for the smallness of the cracks observed in beams reinforced with welded diagonal bars.

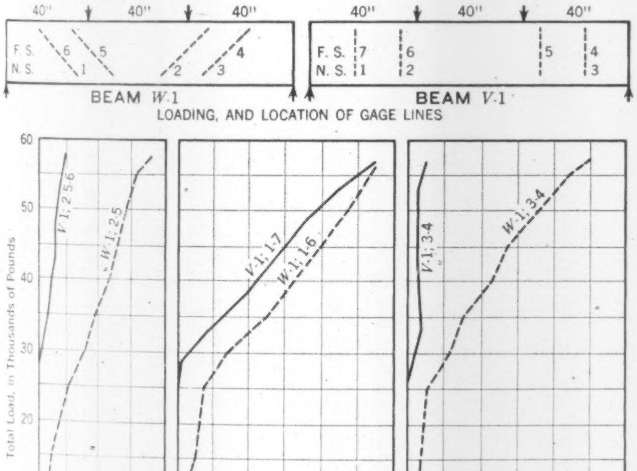
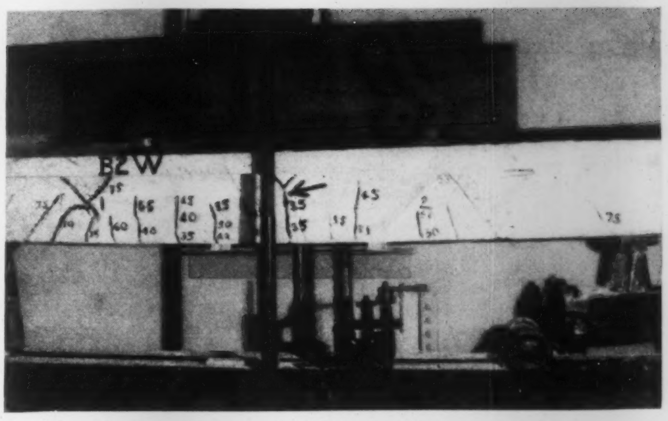


Fig. 3. Load-Stress Curves for Beams W-1 and V-1



Test of Beam with Welded Reinforcement

It is generally recognized that shear calculations for concrete beams are inaccurate. This is obviously true since the most basic assumption used in stress calculations is that the material under consideration remains whole when loaded, whereas vertical stirrups cannot be stressed by beam action until the beam cracks. The curves of Figs. 3, 4, and 5 (*a*) show that shear calculations for vertical stirrups are not only inaccurate but are simply guesses that we are accustomed to dressing up with arithmetic. This fact is illustrated in Fig. 3 by the difference between the graphs of bars 1–7 and 3–4. At a load of 50,000 lb, the stress in bars 1–7 of beam V-1 was about 17 times the stress in bars 3–4, yet the calculated stress for all these bars is the same. The stress as calculated by the formula, $f_v = \dfrac{V's}{A_v jd}$, is from 3.1 to 7.8 times the average stress measured in the stirrups of Fig. 5(*a*).

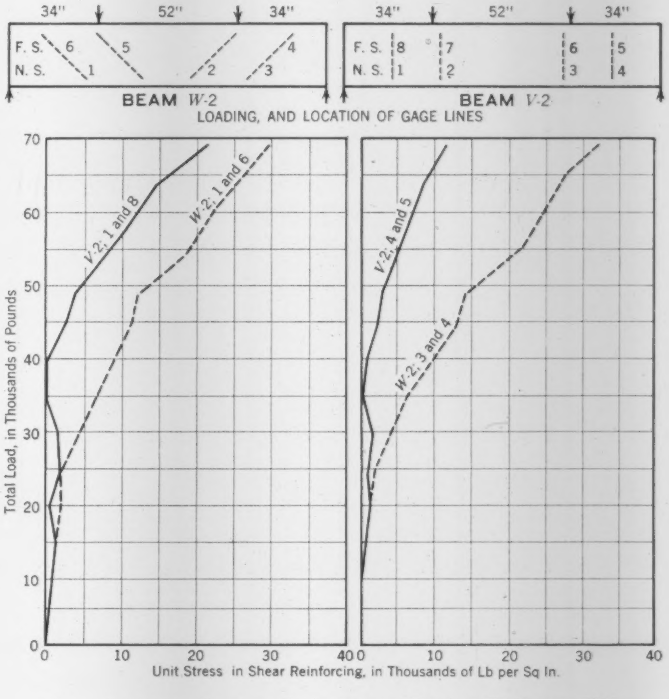


Fig. 4. Load-Stress Curves for Beams W-2 and V-2

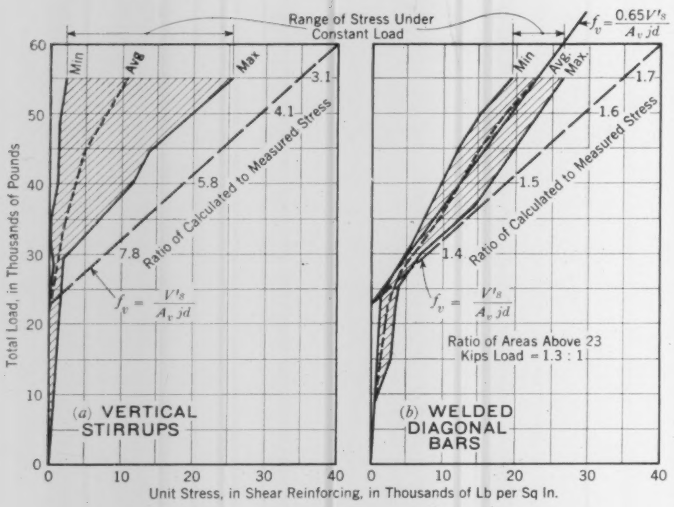


FIG. 5. STRESS IN SHEAR REINFORCEMENT AT VARIOUS LOADS
Note the Marked Departure from the Theoretical Stresses

All this is to say that there is no load-stress relation for loose vertical stirrups.

In Figs. 3, 4, and 5(*b*) the load-stress curves are shown for welded diagonal bars under the same conditions, in the same relative positions in the beams, and with the same steel ratio as the vertical stirrups. The stress as calculated by the usual formula is from 1.4 to 1.7 times the measured stress, in contrast with the ratio previously adduced for vertical stirrups. For this steel ratio, the formula $f_v = \frac{0.65\ V's}{A_v jd}$ practically coincides with the average stress as plotted from strain-gage readings.

There is, then, a load-stress relation for welded diagonal bars.

When selecting stirrups for shear reinforcing, it is customary to assume that a definite amount of the load is carried by the concrete. The remainder is assumed to be carried by the shear reinforcing, and the spacing of stirrups is determined by the formula, $s = \frac{A_v f_v jd}{V'}$.

Figure 6 is plotted to simulate a shear diagram. The blank area (the calculated V_c) is that portion of the total shear assigned to the concrete under Joint Committee specifications, and all above that is supposed to be provided for by the shear steel. The shaded area (the measured V_s) represents the shear actually provided for by the steel, leaving the cross-hatched area out in the cold. The difference in the sizes of these cross-hatched areas for vertical stirrups and for welded diagonal bars is striking. In both instances it can be assumed that the stress in the concrete is more than we bargain for: about three times as much in the beams reinforced with vertical stirrups and 1.4 times as much in the beams reinforced with welded bars.

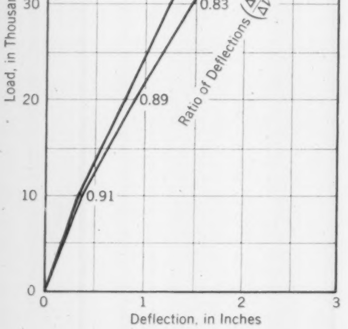


FIG. 7. COMPARISON OF BEAM DEFLECTIONS

Ordinarily, beam deflection caused by shear is so small that it can be ignored without appreciable error. Shearing deflection cannot be expected to exceed 5 to 8 per cent of the bending deflection unless the ratio of length to depth is unusually small. As shown by Fig. 7, the deflections were 8 to 17 per cent less in beams reinforced with welded bars than in those reinforced with vertical stirrups. In other words, the effect of the welded bars was equivalent to eliminating all the shearing deflection and a portion of the bending deflection. This stiffening action is probably produced by the material reduction in the crack width mentioned below.

In one of the tests a beam reinforced with both loose vertical stirrups and welded diagonal bars side by side was tested. The failure was as follows: As the load progressed, the bond on the horizontal bar of the vertical stirrup side gradually failed, throwing all the load on the welded steel; the vertical stirrups came loose from the concrete; at complete failure the beam split along the plane of the welded bars. In the same beam the width of cracks was measured on both sides of the beam. The average width of cracks adjacent to the vertical stirrups was $3^1/_2$ times the average width of those adjacent to the welded bars. The ratio of stress in the welded bars to stress in the vertical stirrups varied from 1.1 to 1 at one-third the total load, to 2.1 to 1 at the last reading.

To determine the strength of a beam under severe conditions of spalling when reinforced with welded units, the concrete was chipped from the bottom of one beam, exposing about half the perimeter of the tension steel for the full length of the beam. The stress in the horizontal steel at failure was past the elastic limit. The anchorage provided by the welded diagonals did not fail.

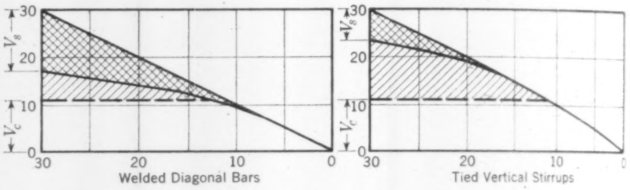


FIG. 6. SHEAR DIAGRAMS (LEFT REACTION TO THIRD POINT)

The sketch of Fig. 8(*a*) shows the usual arrangement of bars in continuous beams. When bent bars and vertical stirrups are used thus, it is necessary to select bars for A_1 and A_3 such that those which are bent up will provide sufficient steel for A_2 while those which are left straight will provide the required amount of compression steel for A_4. If the steel areas for the four sections cannot be juggled to fit all requirements, straight bars may be added in the top to complete A_2. In any case, steel areas for (1) maximum positive moment to the left, (2) maximum positive moment to the right, (3) negative moment at the support, and (4) compression at the support, are interdependent. Very often the steel areas cannot be selected to the desired degree of accuracy and economy.

In Fig. 8(*b*) is shown the proposed steel arrangement using welded diagonal bars. Bars for each section can be selected as required, the top and bottom bars connected by the required amount of diagonal shear steel, and the design completed with some dispatch. The bottom steel that would be bent up in the present-day design may be cut off and hooked, or extended past the point of inflection without hooks, or extended the full length of the beam and lapped at the supports—whichever may be required.

Although no particular emphasis is placed here on the reduction in weight of tension steel, resulting from contin-

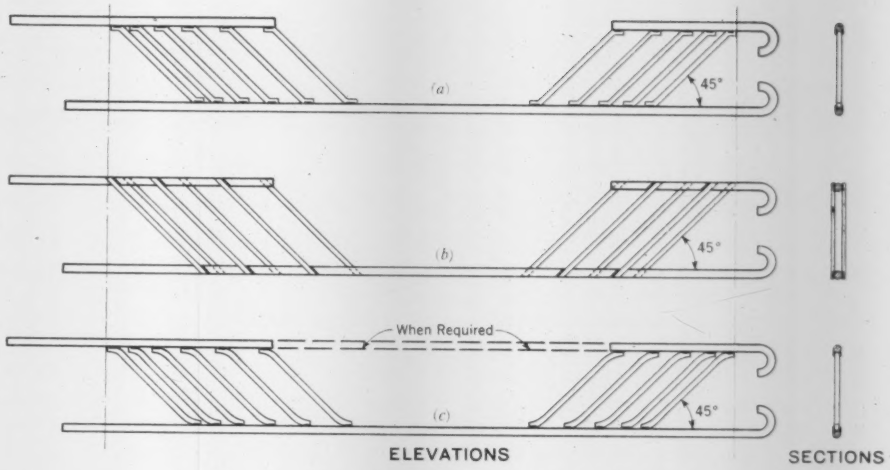


Fig. 9. Optional Methods of Fabrication

uity, it appears from comparative designs that the amount of tension steel will be reduced approximately 5 per cent.

Several welding details were tried during this series of tests. Three of these details are illustrated in Fig. 9. Detail *A* was used in several tests. At ultimate loads, and in combination with vertical stirrups, the welded diagonal bars assumed practically all the load and pulled through the concrete, splitting the beam about like a stonemason's wedge. Detail *B*, in which the shear bars were welded to both sides of the tension steel, was next tried. There was no indication of splitting in the four beams in which this detail was used. Theoretically, details *A* and *B* may both be expected to produce high compressive stresses in the concrete at the joint, the concrete taking the resultant of the two tensile forces in the steel. The tests gave no indication, however, that these stresses need cause any great concern. Detail *C*, with the shear bars bent on a large radius, distributes the resultant over a larger concrete area.

The cost records given in the following paragraphs are for fabricating according to detail *B*. Test results indicate that this detail is satisfactory, but trials in practice may indicate desirable modifications.

Two methods were used to determine relative costs of welded bars and tied stirrups: (1) Reliable contractors were requested to estimate from their records the cost of tying and placing stirrups, and fabricators experienced in welding were asked to estimate the cost of welded units. (2) The operations required to tie the vertical stirrups and to weld the diagonal bars in the laboratory test beams were timed. In both types of beams, the timed operations also included those required to place the steel in position, to assemble the units, and to remove them from the assembling rack. Table I summarizes both the contractors' estimates and the results of the laboratory time studies.

It is recognized of course that these estimates are not exact. Costs of placing vertical stirrups are fairly well known, but the cost of the welded units can only be approximated until they are fabricated in quantity. However, it appears that sufficient information has been accumulated to estimate that the welded shear reinforcing will be about 10 per cent cheaper than vertical stirrups. This does not include any saving in horizontal steel.

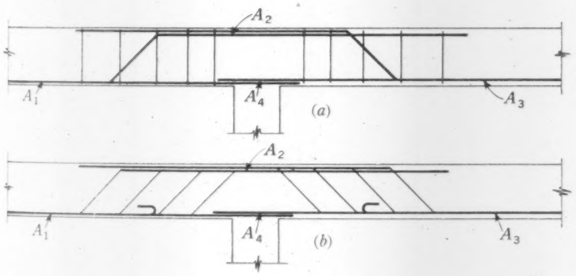


Fig. 8. Arrangement of Reinforcing Over Support with (*a*) Tied Vertical Stirrups and (*b*) Welded Diagonal Stirrups

The following generalized conclusions may be drawn from the investigations reported herein:

1. Single plane units made by welding diagonal bars to top and bottom steel of concrete beams are practicable; they can be fabricated, shipped, and placed without introducing new difficulties. These units provide continuous steel for the beams, permitting the "flow" of stress considered fundamental in all other structural design.

2. The unit stresses in the welded diagonal shear steel can be predicted with a degree of accuracy comparable to that expected in other steel design; with more accuracy, for example, than one can predict the maximum unit stress in a two-angle member of a roof truss.

Table I. Summary of Contractors' Estimates and Laboratory Time Studies

Estimated Costs	
Contractor's estimate of cost of stirrups tied and ready for the forms	6.9 cents per lb
Fabricator's estimate of the cost of welded diagonal bars fabricated and ready for forms	9.5 cents per lb
Cost of enough diagonal bars to provide the same steel ratio as 1 lb of stirrups	6.4 cents
Results of Timed Operations in Laboratory	
Cost of stirrups tied and ready for the forms	6.8 cents per lb
Cost of welded bars fabricated and ready for forms	8.1 cents per lb
Cost of enough welded steel to provide the same steel ratio as 1 lb of vertical stirrups	5.4 cents

Note: Prices used in the laboratory cost calculations: common labor, 30 cents per hr; welder, 75 cents per hr; steel (straight), 2.8 cents per lb; steel (bent), 3.2 cents per lb; welding rod, 8.5 cents per lb; current, 3.0 cents per kwhr. Students were used for both welding and tying, and the labor rates were estimated very low—about 65 per cent of the rate for similar work in the field—to allow for their inexperience.

3. The welded units materially stiffen the beams and reduce cracking.

4. The welded units will cost less per beam than the assemblies now used.

Although rather voluminous records have been accumulated in the course of this research, the work done is far from complete. Possibly the most promising procedure would be a series of tests on continuous beams. If job conditions are to be reproduced, it will be necessary to make large-scale tests and measurements on beams in which maximum moment and maximum shear occur at the same section.

Beams loaded to destruction and designed to fail in shear should give some idea of relative safety factors provided by tied stirrups and welded diagonal bars. And if sufficient beams were built, costs of assembly could be compared with more accuracy. A study of the relative effectiveness of the two systems in resisting repeated loads would be very informative.

The Care of Surveying Instruments

With Comments on the Materials Used in Their Construction

By L. H. BERGER

PRESIDENT, C. L. BERGER AND SONS, INC., BOSTON, MASS.

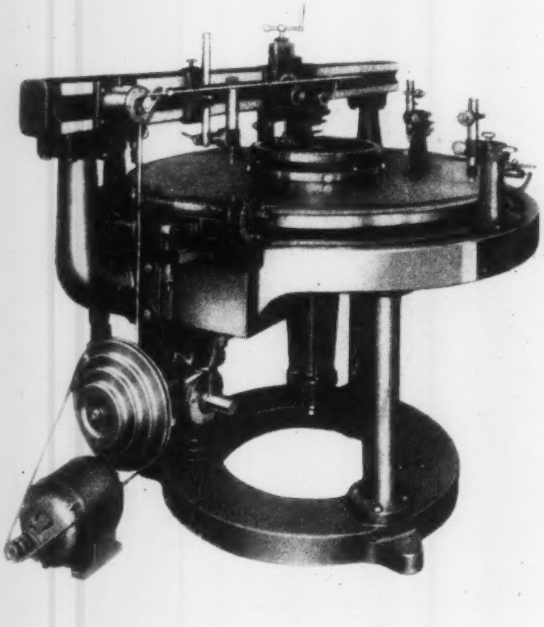
JUST what the surveyor should and should not attempt to do for himself in servicing and repairing his instruments is the first principal topic of this paper. Valuable suggestions are offered on such points as cleaning, oiling, and taking the telescope apart. Further on, Mr. Berger discusses a number of items of particular interest to those concerned with the writing of specifications for instruments—the proper sensitivity of spirit levels, the relative merits of various materials used in instrument construction, and so forth. This article is abridged from a paper on the program of the Missouri regional conference for surveying teachers and practicing engineers, held at Rolla, Mo., in April 1939, under the joint auspices of the Civil Engineering Division of the Society for the Promotion of Engineering Education and the Missouri School of Mines and Metallurgy.

LIKE all instruments of precision, surveying instruments require the greatest care in handling. However, unlike other delicate devices, they not only are subjected to climatic conditions of the severest nature, but are accorded various kinds of especially rough treatment. Because of this, it is essential that the user should be instructed as to the proper care of whatever instrument he is required to use, and the precautions he must take to avoid serious trouble.

It is the custom of many engineers and surveyors to return their instruments to the factory at least once every six months for inspection and proper cleaning and oiling. Also, such careful users are aware that when accidents have occurred, it is much the best rule to send the instrument to the maker for repairs and adjustments. However, every user should be sufficiently acquainted with his instrument to make at least adequate makeshift repairs when an emergency occurs. He should also learn to discriminate carefully between the adjustments and repairs which he can and ought to make himself and those which he should not attempt. Harm may be done both by neglecting to make repairs and by trying to perform in the field a delicate operation which only the maker, with the proper equipment, should attempt.

Common sense is a safe guide in the handling of instruments. One of its dictums, for instance, is that a transit or a level should be lifted by the leveling base or foot plate—the structural supports designed to serve as its foundation. To lift an instrument by the telescope or under the horizontal circle is to take unwarranted liberties with what is really its heart, which should certainly not be subjected to needless strains. If it is necessary to lift an instrument by its superstructure, it is advisable to grasp the base of the standards near the horizontal plate, being careful during the lifting not to exert any lateral pressure.

Sensitive and careful treatment of a surveying instrument is necessary even in its leveling. It is possible through binding one of the screws of a four-screw leveling base to apply a pressure of several hundred pounds. It is easy to imagine the distortion which continual application of this pressure can produce on the socket of the leveling head. What is even more injurious is that this pressure is transmitted as a direct thrust on to the vertical spindles of the instrument.



AN AUTOMATIC DIVIDING ENGINE
This Machine, Used for Dividing Circles of All Diameters from 4 to 40 In., Has an Accuracy of 1 Second of Arc

Protection should be afforded instruments when used in bright sunlight. Sensitive spirit levels of transits and levels ought to be protected from the direct rays of the sun whenever possible. A cloth hood should be provided to cover the instrument when it is not in actual use.

Telescopes as now constructed with interior focusing (Fig. 1) require very little care and adjustment. It is better to put up with such annoyances as a small amount of dust on the cross-hairs or on the inside surface of the lenses until the instrument can be sent to the maker. The exposed lenses should be dusted with a scrupulously clean piece of linen, free from lint, applied with a light circular motion.

A properly constructed telescope is provided with small air vents to prevent the creation of a vacuum in one end of the tube when the slide is being focused. Lack of proper ventilation in the telescope tube causes the condensation known as "dew-drops" to gather on the cross-hairs and on the surfaces of the various lenses. This condensation will gradually disappear when temperatures have been equalized.

REMOVING THE DIAPHRAGM

Unless experienced, one should not attempt to adjust or clean the cross and stadia wires. Actually they seldom need adjusting or cleaning, and an inexperienced person attemping it may change the telescope's line of collimation. If an engineer is going into remote sections it is better for him to take along with his instrument an extra diaphragm. However, should it be found necessary to clean the diaphragm wires the following procedure is advised (in this connection see Fig. 2):

With an erecting telescope (whether of the exterior or interior focusing type): (1) Unscrew the object glass by turning it to the left. (Before doing so, observe whether there are any marks to show how far the cell is to be turned to place it in the correct position. If there are none, a small mark should be made parallel to the line of collimation which will extend from the edge of the cell to the collar. When the cell is put back, it must be turned until these marks coincide exactly.) (2) Remove the focusing pinion, and carefully draw out the focusing slide. (3) Remove the telescope spirit level. (4) Remove the two capstan-head screws and their washers at the right and left of the cross ring. (5) Loosen the remaining screws to such an extent that the ring may be turned 90 degrees. (6) Insert a long, sharp-pointed stick into the hole nearest the objective end of the telescope, so as to hold the diaphragm. (7) Remove the two remaining screws, and take the diaphragm out on the stick.

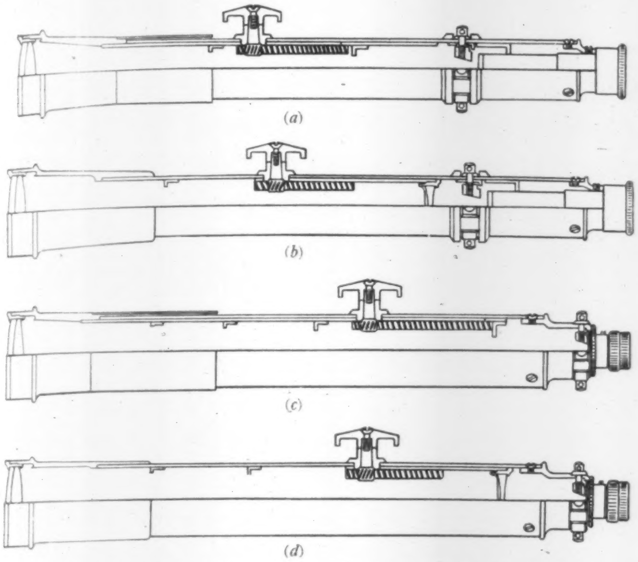


Fig. 1. Focusing Systems for Transit Telescopes

(a) Erecting, with Exterior Focusing Slide—Five Lenses; (b) Erecting, with Internal Focusing—Six Lenses; (c) Inverting, with Exterior Focusing Slide—Three Lenses; (d) Inverting, with Interior Focusing—Four Lenses

With an inverting eyepiece, the diaphragm is more easily taken out through the eyepiece end of the tube. It is not necessary to detach the telescope level or to remove the object glass, the focusing pinion, or the slide. First remove the two opposite screws having slots which hold the eyepiece in its mounting in the outer barrel of the telescope. Then slightly release all four diaphragm adjusting screws. Remove the entire eyepiece mounting. Then, by taking out two opposite diaphragm screws and inserting a sharp-pointed stick, the diaphragm can be removed as in the case of the erecting telescope.

The cross-wires may be cleaned by using a small wedge-shaped piece of fine-texture tissue paper, moving it gently forward and back along the wires. This operation requires a very steady hand and the use of a reading glass to prevent cross-wire breakage.

OTHER COMMENTS ON TAKING TELESCOPE APART

A few additional remarks on taking the telescope apart may be in order at this point, though it should be stressed that they are offered for use only in an emergency. To remove the interior lens, or to make other necessary repairs to the interior focusing slide, requires the services of an experienced instrument maker, and should not be attempted in the field.

The removal of an interior focusing slide calls for a different procedure from the removal of the exterior type. After the objective and focusing pinion are removed, the telescope should be held in a vertical position so that the weight of the slide will force it to come out. The hand, or still better, some soft material such as a clean linen towel, should be held as a cushion under the slide to receive it and to prevent it from becoming damaged. In replacing the slide, one should be sure that both it and the lens are perfectly clean.

Most eyepieces of erecting and inverting telescopes now have protection guards for their slides. The correct procedure for removing such an eyepiece is as follows: (1) To take out the erecting eyepiece, first remove the dust cap, to which the protection guard for the slide is attached. Then remove the screw in the spiral slot to be found near the end of the main tube; take hold of the eyepiece and pull it out gently. (2) To take out the inverting eyepiece, first unscrew the eyepiece cap, unscrew the protection guard for its slide, remove the spiral slot screw, and then take hold of the eyepiece and pull it out gently.

FOCUSING SLIDE NEEDS NO LUBRICATION

When the manufacturer has selected the correct metals for a focusing slide and the barrel in which it travels, and the slide has been painstakingly fitted, the slide or barrel never requires lubrication of any kind. This is also true of the objective lens slide, found on the older types of instruments. If these parts are oiled, the lubrication will harden in cold weather, so that the slide will move only under undue force; in warmer weather the oil will thin, causing a dust-bearing and fogging medium to be freed within the telescope barrel, which will be deposited on the cross-hairs and on the surfaces of the lenses.

If the focusing slide frets, a little fine watch oil may be applied as an emergency practice, but the instrument should not be used more than necessary before being repaired, in order to prevent this fretting condition from becoming worse.

If the standards supporting the telescope are designed along sound structural lines, they require but little attention. The bases of the A-shaped standards and the base of the yoke standard frame, both of which types are mounted on the horizontal vernier plate, should be sufficiently large to provide firm lateral support to the telescope. It not, trouble may develop in the trunnions or telescope axes.

If a fall occurs, it is usually one of the standards that suffers most. Emergency repairs in such cases are generally arduous, and it should be remembered, when a standard becomes bent, that the instrument maker is the one who has the special equipment required to straighten it properly.

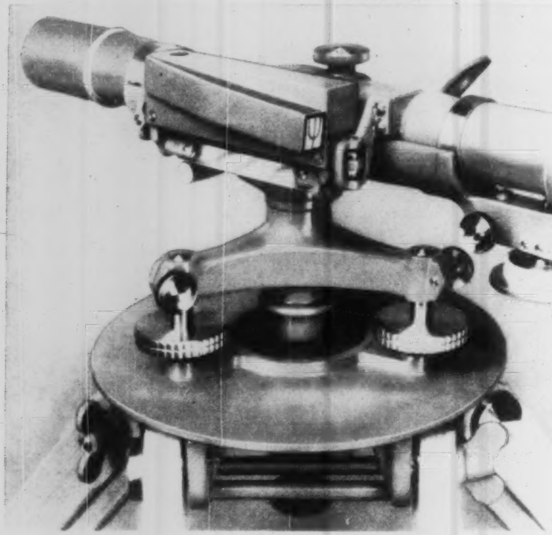
Trunnions should be oiled frequently, with the best grade of oil, to preserve their true form.

With either an external or an internal focusing slide, the telescope is bound to be slightly out of balance when focused for short distances. The question has often been asked, "Which is the better practice in order to preserve its balance—to tighten the telescope slightly with a clamp, or to provide the axis trunnions with brakes?" Braking the trunnion axis (by forcing the metal caps of the standards down on the trunnions) may in time prove injurious to the axis through increasing wear; and there are obvious objections on similar grounds to the common method of braking the telescope by tightening the clamp slightly, and tapping the telescope into position with the finger. The only really satisfactory method is the one for which the instrument is designed;

namely, to clamp the clamp-screw tightly, and use the tangent slow-motion screw to get the exact sight.

SUGGESTIONS ON CLEANING AND OILING

It is of course necessary for a surveyor to be able to disassemble his instrument for cleaning and oiling, as well as to make the proper field adjustments. As a practical precaution, frequent cleanings seem to be the best preventive of instrument trouble. Of course an instrument should never be cleaned where dust or dirt is present; a clean bench and a dust-free room are prime requisites. An orderly arrangement of the disassembled parts is also necessary to insure their uninterrupted and proper reassembly. Particular care should be taken to place the graduated circle in such a position that no dirt will possibly get on its surface.



A PRECISE TILTING DUMPY LEVEL
Note the Three-Screw Leveling Base and the Prismatic Device for Reading the Telescope Spirit Level

When the parts needing attention have been disassembled, the first operation is to remove all traces of the old oil. The instrument should be thoroughly cleaned before any re-oiling is attempted. An absolutely clean chemical solvent that leaves no residue, such as naphtha or benzine that has not previously been used, should be employed. This should be applied with a piece of good-grade linen, which has been thoroughly washed and is absolutely free from lint. It is important to clean both the spindles and the sockets, or the purpose of the cleaning is defeated. The flanges of the spindles and their upper rests should be cleaned with another clean rag to remove all traces of film left by the solvent.

The proper way to oil the instrument centers is to apply a few drops to the spindles and their sockets, and their respective flanges. No harm is done if the oil is applied liberally, but there is no point in wasting it. The vernier plate clamp, the horizontal circle clamp, and the telescope clamp should also be thoroughly cleaned and oiled.

Leveling screws should be cleaned with naphtha or benzine, applied with a stiff clean typewriter brush. No heavy lubricants or greases should be applied, as dust will readily adhere to such substances and settle on the screws. Vaseline should not be put on screw threads, as it is likely to harden, especially in winter, causing the screws to move very stiffly.

When the instrument is apart, the graduated circle may be lightly dusted with a fine camel's-hair brush. But no attempt should ever be made to clean the graduations—even with abrasives as fine as optical rouge—and silver polish, even of the highest grade, should never be used. Another "don't" is this: The graduations of the horizontal circle, after cleaning, should never be coated with a film of oil or vaseline, however thin, as any film is likely to overflow across the graduated lines and cause erroneous angular readings. For the same reason, in servicing an instrument, when it becomes necessary to remove the tarnish from an accurately cut graduation on sterling silver, a coat of transparent lacquer should not be applied.

Use of the best oils and lubricants on the market is a prime factor in lowering the maintenance cost of surveying instruments. Only the finest grades of watch or clock oils should be applied. Light machine oils, however purified they may be, are not suitable, and oils of the penetrating or cutting type should not be allowed even on the same bench as the instrument. It is worth noting that oils and greases formerly recommended by instrument manufacturers have in many instances been discontinued because superior products are now available. Certain excellent watch and clock oils made by various companies work well at even 20 degrees below zero.

Tools such as screwdrivers, spanner wrenches, and adjusting pins should be of reasonable fit to prevent the burring of screws. These tools are a part of the equipment furnished with every transit, so there is rarely need for substitute devices. Such makeshift implements as brads, wire nails, and surveyors' tacks are very poor substitutes.

Care should be exercised if long adjusting pins are used, because there is likelihood of applying too strong pressure and thus stripping the threads of screws or nuts.

POINTS TO CONSIDER IN INSTRUMENT SPECIFICATIONS

The recent increased demand for modern precise instruments, caused by the epoch-making activities in geodetic control surveys, is worthy of note. This demand will of course have its effects on the design of surveying instruments of all types, and the new specifications may be expected to insure more accurate results than have hitherto been universally required. The remainder of this article is devoted to a brief consideration of various points that may well be taken into account in such specifications.

For general engineering practice the compact instruments equipped with a four-screw leveling base will probably always constitute the bulk of the instruments manufactured in America. However, for high-precision instruments—such as theodolites with verniers reading to 10 seconds, and the precise tilting Dumpy levels used in first- and second-order leveling—a three-screw leveling base is to be preferred. The three-screw base, owing to the greater radius of the leveling screws, makes for more stability of the superstructure of the instrument, particularly in a high wind. Besides this, it facilitates the leveling of the instrument, and precludes the possibility of strain caused by excess pressure of the screws.

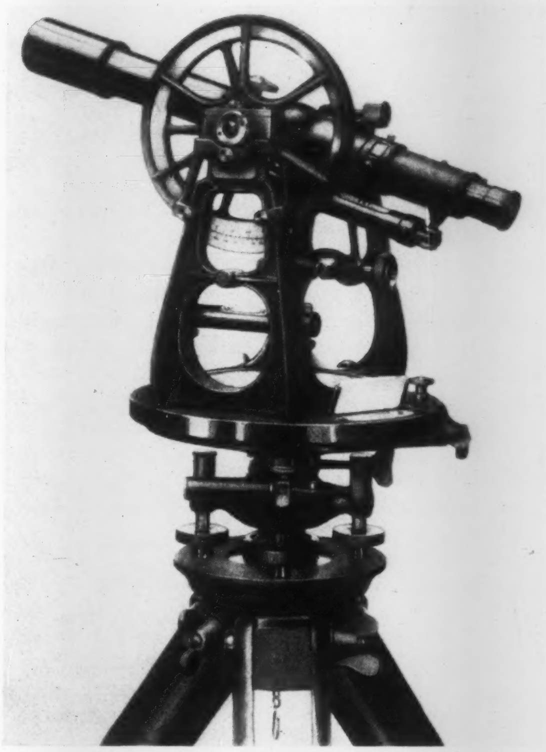
All too often transits, theodolites, and leveling instruments are equipped with insensitive spirit levels. It is not unusual to discover a transit or theodolite the plate levels of which have a value of only 2 minutes of arc, even though the horizontal verniers of the transit may read to 20 seconds, and those of the theodolite to 10 seconds.

In my opinion instruments equipped with such insensitive spirit levels should never be employed when accurate surveys are to be made. Spirit levels, to be satisfactory, should have at least sufficient sensitivity to be consistent with the powers of the telescope and the fineness of the graduated limbs and verniers; and when level vials need replacement, the surveyor should be sure that the servicing department furnishes him with new vials of that sensitivity. Recommended values are as follows:

When the A and B horizontal verniers of a transit read to a single minute, or even to 30 or 20 seconds, be the size of the instrument $6^{1}/_{4}$, $5^{1}/_{2}$, or $4^{1}/_{2}$ in. at the edge of graduation where the reading is made, the plate levels should have a sensitivity of at least 60 seconds of arc measure for each 2-mm division of the graduated scale etched upon the outside of the vial.

The telescope vial for an ordinary transit, wye or Dumpy level, can be either 30 or 20 seconds, depending upon the sensitivity required by the engineer.

A 7- or 8-in. theodolite, with A and B verniers reading to 10 seconds, should have plate level vials with a sensitivity of 45 seconds for each 2-mm division. When a telescope vial is to be added to this type of instrument, it can have a sensitivity of either 20 or 30 seconds.



Both Precision and Sturdiness Are Required of the Modern Surveying Instrument

A Rigid, Yoke-Shaped Frame, Protection for Delicate Parts, and Cylindrical Trunnions for the Telescope Axis Are Features of Note in the Transit Shown Here

The inner surface of a spirit level should of necessity be ground to a constant radius of arc; it should be barrel-shaped. The air bubble, or blister, should move very smoothly without hitching for any part of its traveling distance. The vial should never be filled with a slow-traveling fluid, such as wood alcohol, synthetic alcohol, or even grain alcohol. The proper fluid is a mixture of two-thirds high-proof filtered grain alcohol and one-third filtered ether—the best obtainable, since cheap commercial ether will attack the inner surface of the vial, causing pitting, which will obstruct the flow of the blister and result in inaccuracies in leveling up the instrument. Instruments for use in the Arctic should have vials filled with the purest ether. This is the only non-freezing fluid suitable for use in extremely cold climates.

MATERIALS FOR SURVEYING INSTRUMENTS

Although leading manufacturers have built, to the purchasers' specifications, many instruments of special design with certain parts made of aluminum or aluminum alloys, the responsibility for proper functioning of such instruments is naturally that of the parties who draw up the specifications. These alloys, if used at all for field instruments, must be used with extreme caution.

To have stability in high winds, or when otherwise subjected to vibration, an instrument should have considerable weight. Nothing can be achieved by the engineer under such conditions if his instrument is too light, and this is likely to be the case if most of its parts are of aluminum. Again, parts made of aluminum will wear out very quickly if they revolve or travel in other parts of the same material, since this metal flakes and causes "freezing" and fretting.

That stable metal, bronze—time tested and proved to be the best material for the construction of instruments—has reached a high degree of perfection through recent advances in metallurgy, and should not be lightly discarded. Certain other metals do, of course, have their place in instrument design. For example, the vertical centers, or spindles, of such instruments as theodolites should not be made of bronze, but of tool steel or similar material (not hardened or tempered), revolving in sockets of soft gray iron, as these materials are less susceptible to temperature changes that affect the accuracy of high-precision instruments.

Metals used for the parts on which graduations are cut—that is, the horizontal and vertical circles and their verniers—include nickel silver (commonly known as German silver), brass, bronze, aluminum, solid silver, and sterling silver. Nickel silver, brass, and bronze are altogether too hard to take accurately spaced graduations; with any of these metals it is difficult to obtain the proper width, evenness, and depth of line. On the other hand, solid silver is much too soft, and the edges of the graduations where the reading of the vernier is made can easily become damaged in cleaning. Aluminum is sometimes selected because of its light weight and because it is said to be more free from the effect of tarnishing than is solid or sterling silver. However, graduations cut on aluminum, like those on brass or bronze, usually appear quite ragged and jagged under a microscope. Such lines are not conducive to accuracy.

With proper automatic dividing engines, accurate graduations are best produced on sterling silver (925/1,000 fine), which is neither too hard nor too soft. An accurate graduation should have deep, sharp, V-shaped cuts, uniform in width for their entire length.

In substantiation of these remarks on the proper metal for graduations, the following incident may be cited. Some months ago one of the federal departments that purchases instruments in large quantities specified in its bid forms that manufacturers would have to graduate the vertical arcs and verniers on nickel silver, and later specifications from the same department called for graduations on aluminum. However, their most recent bid forms specify that all graduations shall be cut on thick, hard-rolled sterling silver.

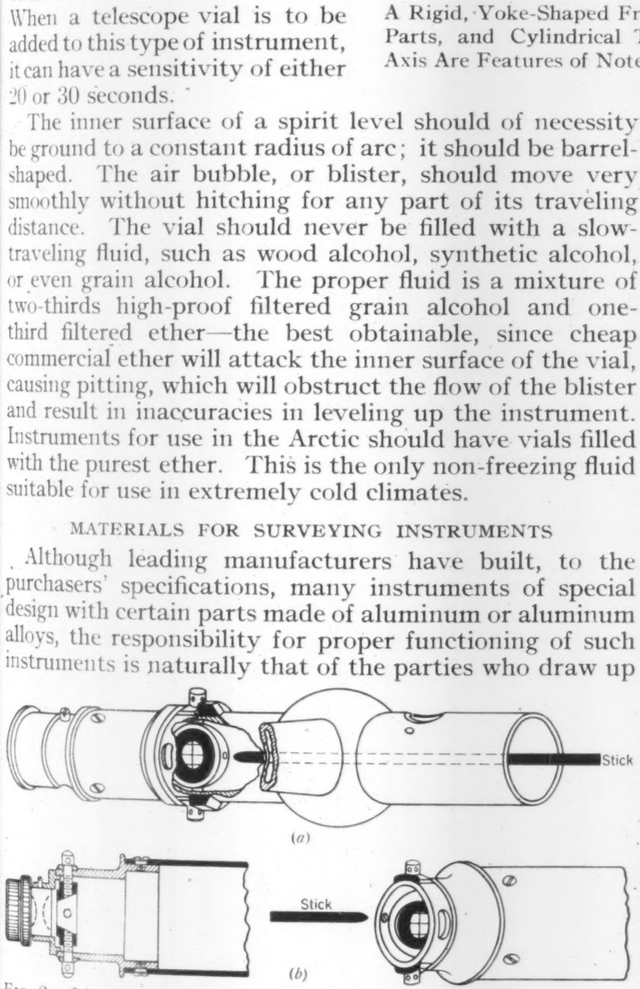


Fig. 2. Method for Removing Diaphragm from (a) Erecting and (b) Inverting Transit Telescope

Some Interesting Engineers of Antiquity

Many of the Human Problems They Faced Still Plague Their Modern Confreres

FROM AN ADDRESS RECENTLY DELIVERED AT KANSAS STATE COLLEGE

By E. E. HOWARD, M. AM. SOC. C.E.
ASH-HOWARD-NEEDLES AND TAMMEN, CONSULTING ENGINEERS, KANSAS CITY, MO.

IN a recent address Dean T. R. Agg, M. Am. Soc. C.E., made the very interesting statement that the word "engineer" was not derived from the word "engine," which of old referred to any mechanism, nor yet from the word "ingenuity," as some dictionaries indicate. "Engineer," he said, came from an old French word which meant "to seek in one's soul a means of accomplishment." Not all words retain so much of their original significance. Engineering includes not only the conception, the imagined result, but also the means of bringing about that result—whether it be a dam, a highway, a coil for a telephone, an airplane propeller, an automobile engine, a mine shaft, or a machine to make other machines.

Long before the dawn of history man had found ways to move and handle weights of considerable magnitude—not by any magic, or lost art, but by the sensible application of the forces and facilities he could command. This was, of course, long before the building of the pyramids—and that was more than 5,000 years ago. By that time the technical development of engineering included mathematical calculations and surveying and the use of plans or models to show the craftsman what the designer had conceived. Certain men became specialists. They majored in the art and science of construction and manufacture—they became engineers.

A WISE MAN EMPLOYS A CHIEF ENGINEER

When Solomon wanted to carry out David's plan and build a temple he had none among his own people expert in construction. They were nomads, herdsmen, who had but recently settled down to farming. So Solomon assigned a great many of them to do common labor, "to bear burdens" and "to hew in the mountain." He then made a contract with Hiram, King of Tyre, for his engineers and craftsmen as well as for three kinds of lumber, and paid with wheat and barley, and wine and oil.

So Hiram sent down an experienced chief engineer, "endued with understanding." Hiram said the man had worked for his father, and was expert in handling gold, silver, brass, iron, stone, and timber, and also understood color decoration. We can agree that Solomon was a wise man, for when he wanted to build a temple he employed experts to do the work.

But this is only a familiar example of comparatively late construction (about 950 B.C.). We cannot say when engineers first began to build by experiment and by calculation instead of by trial and error or by folklore traditions, but it was far earlier than might be thought. The engineer today has the advantage of all the accumulated knowledge of the laws of nature and qualities of materials—of all the experience of those who have preceded him. He has at his command the greatest variety of tools, of materials, and forces the world has ever known. The most important tools of the engineer are not steam hoisting engines, gasoline pumps, and electric motors. He could build without these. The one most important tool he has is mathematics—mathematics and the accumulated knowledge of physics and mechanics.

There is a vast field of interest in ancient engineering structures—the bridges and aqueducts of Rome; water supply tunnels like Hadrian's in Athens; irrigation canals like those of Sennacherib, which brought water to Nineveh; Queen Hatshetsup's canal from the Nile to the Red Sea, forerunner of the Suez Canal; the structures of Baalbek in Syria; the constructions in Mesopotamia and Egypt. However, I would prefer to deal here with a few individual engineers of past ages. We cannot find complete life stories of any of them, but the few incidents we can glean show how like their problems were to those of the engineer today. Altogether they seem very human.

PROBLEMS OF AN ANCIENT TUNNEL BUILDER

Take Nonius Datus. He was a consulting hydraulic engineer in the second century A.D. and designed a tunnel for the water supply to Saldae in North Africa. Some time later he went back to inspect the work, where the tunnel had been started from both ends, and we have a part of his report:

"I found everybody sad and despondent. They had given up all hopes that the two opposite sections of the tunnel would meet, because each section had already been excavated beyond the middle of the mountain.

"As always happens in these cases, the fault was attributed to me, the engineer, as though I had not taken all precautions to insure the success of the work. What could I have done better! I began by surveying and taking the levels of the mountain. I marked most carefully the axis of the tunnel across the ridge. I drew plans and sections of the whole work, which I handed over to Petronius Celar, Governor of Mauritania; and to take extra precaution I summoned the contractor and his workmen and began the excavation in their presence with two gangs of experienced veterans, namely a detachment of Marines and a detachment of Alpine troops. What more could I have done?

"After four years absence, expecting to hear every day the good tidings that water had been brought to Saldae, I arrive. The contractor and his assistants have made blunder upon blunder. In each section of the tunnel they had diverged from a straight line, each towards the right; and had I waited a little longer before coming, Saldae would have possessed two tunnels instead of one."

We are told that Nonius Datus resurveyed the work and put in a transverse tunnel connecting the two tunnels. This must have been skillfully done with the kind of surveying instruments he had. These no doubt included a *groma* or a *dioptra* for alinement, and a *chorobates*, which made use of both a water bubble and a plumb line for a level.

A ROMAN CONTRACTOR "GOES BROKE"

Then there was a contractor in Rome, in the first century B.C., who was daring and ingenious but had bad luck. His name was Paeonius. He was the lowest and best bidder for the transportation and delivery of a stone 12 ft long, 3 ft wide and 6 ft high, for the base of a statue of Apollo. Paeonius had an ingenious idea, although I surmise that some of the unsuccessful bidders ridiculed it. At any rate, Paeonius constructed two wooden wheels 15 ft in diameter, one placed at each end of the stone so that the stone stood as an axle. He connected the two wheels around their circumferences with pieces of wood 2 in. square, not more than a foot apart, extending from wheel to wheel, and thus enclosing the stone. . . . . Round these bars a rope was coiled, to which the traces of the oxen were made fast, and as it was drawn out the stone rolled on by means of the wheels." But alas! "The machine would not keep a straightforward path and was in need of constant rectification—so much so that Paeonius was at length without money to complete his contract."

Poor Paeonius! What a world of human ambition and endeavor, disappointment and discouragement, is covered by those few terse lines! I think of Paeonius as rather young, without much capital or political influence, but with an inventive turn of mind and a courageous spirit—mature enough to convince the Board of Aediles of the Temple of Jupiter that he could carry out the project, but young enough to venture out and risk everything he had on his idea. Not rich, or he would not have been without money for completion. No politician, for no contractor in Rome in his time with real political influence would have "gone broke" on a public contract.

One can imagine the talk afterwards—one Aedile saying to another, "I never did think that young fellow could carry out that foolish idea. I voted to award him the contract only because you insisted upon it." And the other contractors would be sympathetic, but privately they would say, "Well, at least one more price-cutting bidder is eliminated. His bid was away below our mere labor cost. Why did those Aediles risk a big job like that with a fellow who is nothing more than a sidewalk contractor?" And Paeonius, "If I could only get a little more money, I know I could make it work."

A CITY PLANNER OF THE FOURTH CENTURY B.C.

Sometimes we think that all old cities grew by chance and without a plan, that city planning is a recent idea. A city that for three hundred years was not only a great center of trade, riotous with life, but also the center of learning, renowned for its mathematicians, astronomers, and engineers and for its libraries, was planned by an engineer named Dinocrates. And he laid it out with trafficways and main streets and minor streets and public squares and parks. This city has been continuously occupied for some 2,200 years.

Here is the story of Dinocrates, in a direct translation: "Dinocrates, a consulting engineer of Macedonia, relying on his skill and ingenuity, whilst Alexander was in the midst of his conquests, set out from Macedonia to the army, desirous of gaining the commendation of his sovereign." That, of course, means to get a government job. "That his introduction to the royal presence might be facilitated, he obtained letters from his countrymen and relations to men of the first rank about the king's person; by whom being kindly received he besought them to take the earliest opportunity of accomplishing his wish. They promised fairly but were slow in performing, waiting, as they alleged, for a proper occasion." That sounds modern! "Thinking, however, they deferred without just grounds, he took his own course for the object he had in view. He was, I should state, a man of tall stature, pleasing countenance and of dignified appearance. Trusting to the gifts with which Nature had endowed him, he put off his ordinary clothing, anointed himself with oil, crowned his head with a wreath of poplar, threw a lion's skin over his shoulders, and, carrying a large club in his right hand, he sallied forth to the royal tribunal when the king was dispensing justice.

"The novelty of his appearance excited the attention of the people; and Alexander, soon discovering with astonishment the object of their curiosity, ordered the crowd to make way for him and demanded to know who he was. 'A consulting engineer of Macedonia,' replied Dinocrates, 'who suggests schemes and designs worthy of your royal renown. I propose to carve Mount Athos into the statue of a man holding a spacious city in his left hand and in his right a huge vase, into which shall be collected all the streams of the mountain, which shall thence pour into the sea.'" Dinocrates thus anticipated Gutzon Borglum's mountain carving by some 2,000 years.

Alexander was pleased with the idea and made inquiries to determine whether the soil of the neighborhood was suitable to support such a city. When he was advised that the site was not suitable, he told Dinocrates he would not build a city there, but said, "I nevertheless request your attendance on me that I may otherwise avail myself of your ingenuity." In other words, he said, "Stick around and I may have a job for you later." "From that time, Dinocrates was in constant attendance on the king and followed him into Egypt, where Alexander having perceived a site at the same time naturally strong, the center of commerce of the country, a land abounding with corn and having facilities for transport which the Nile afforded, ordered Dinocrates to build a city whose name should be Alexandria." This is how the city planner of Alexandria got his job.

One cannot recommend that an engineer go out with a club in his hand to secure employment, but he still must be able to produce ideas and schemes worthy of attention.

An early contracting organization was the Eupalinas Company of Megara. About 600 B.C. that company contracted with Polycrates and built a tunnel 8 ft square and about a mile long to supply water to Samos. A few years later the same company built a water supply system for Athens with vitrified clay pipes, without tunnels. Eupalinas evidently was a good dirt mover as well as a hard rock man. His company seems to have worked principally on a cost-plus basis.

To look at the past of engineering is entertaining; to look at the future inspiring. The engineer has, I think, proved himself. Society has come to understand the services the engineer has rendered and can render.

Life today is much more complex than when the pioneers wrested this country from the wilderness, and we are told that it will become increasingly more complex as those pioneer days drop farther and farther behind. The field of engineering increases with this complexity. Primitive life requires a minimum of engineering work; complex life demands the maximum. No matter what catastrophic changes—governmental, economic, social—may come, there will always be more and more work for the engineer. Men may change their ideas and overthrow governments and social systems, but it will be largely because they want more and not less of the comforts of life, of the conveniences that engineering has produced and can produce.

Many years ago I placed on a bridge an inscription compiled from the philosophy of Buckle in his *History of Civilization*, and with that I wish to close:

"Formerly the richest countries were those in which Nature was most bountiful. Now the richest countries are those in which man is most active. For in our age of the world, if Nature is parsimonious, we know how to compensate for her deficiencies. Our engineers can correct the error and remedy the evil. For the powers of Nature, notwithstanding their apparent magnitude, are limited and stationary; but the powers of man, so far as experience or analogy can guide us, are unlimited."

ENGINEERS' NOTEBOOK

This department, designed to contain ingenious suggestions and practical data from engineers both young and old, should prove helpful in the solution of many troublesome problems. Reprints of the complete department, 8½ by 11 in., suitable for binding in loose-leaf style, are available each month at 15 cents a copy.

Torques or Twisting Moments Applied as Loads Parallel to Beam Axes

By William J. Bobisch, Jun. Am. Soc. C.E.
Assistant Engineer, U. S. Bureau of Reclamation, Denver, Colo.

There are times when a moment may be applied as a load to a structure instead of a force, or in conjunction with a force. When the member to which such a moment is applied is of uniform cross-section and fixed at the ends, the bending moment curve can be drawn very quickly from the influence lines presented in Fig. 1. When a beam of uniform cross-section is not fixed at the ends, the influence lines also may be used in conjunction with moment distribution.

In Fig. 2(*a*), the applied moment is +2 ft-kips, at a relative distance k from the left end equal to $6/10 = 0.6$. Using Fig. 1(*a*), it is found that the bending moment at the left support of the beam $M_A = +0.32m = 0.32 \times 2 = +0.64$ ft-kips. Similarly, the bending moment at the right support $M_D = -0.12m = -0.12 \times 2 = -0.24$ ft-kips. Similarly, using Fig. 1(*b*), the bending moment just to the left of the point of application of the moment M_B is -0.54×2, or -1.08 ft-kips, and the bending moment just to the right of the point of application of the moment M_C is $+0.46 \times 2$, or $+0.92$ ft-kips. The curve of moments will therefore look as shown in Fig. 2(*b*).

For the case shown in Fig. 3(*a*), the first step in the solution is to draw the curve of moments for *CB*, assuming that joint *C* remains fixed. The result will be as shown in Fig. 3(*b*). Next, distribute the end moments of *BC* (see Fig. 3*c*). Finally, superpose these new end moments on Fig. 3(*b*), to obtain the true moment curve, Fig. 3(*d*).

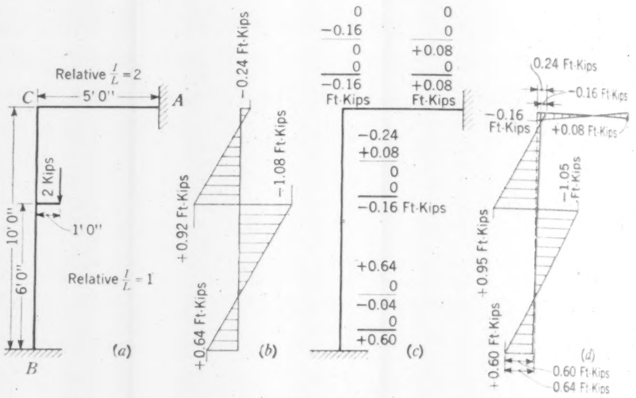

Relative $\frac{I}{L}$ = 2
C
5' 0"
A
2 Kips
1' 0"
10' 0"
6' 0"
Relative $\frac{I}{L}$ = 1
B
(a)
−0.24 Ft-Kips
−1.08 Ft-Kips
+0.92 Ft-Kips
+0.64 Ft-Kips
(b)
0
−0.16
0
0
−0.16
Ft-Kips
0
0
+0.08
0
+0.08
Ft-Kips
−0.24
+0.08
0
0
−0.16 Ft-Kips
+0.64
0
−0.04
0
+0.60
(c)
0.24 Ft-Kips
−0.16 Ft-Kips
−0.16 Ft-Kips
+0.08 Ft-Kips
−1.05 Ft-Kips
+0.95 Ft-Kips
+0.60 Ft-Kips
(d)
0.60 Ft-Kips
0.64 Ft-Kips

Fig. 3. Case Involving Moment Distribution

When a moment is applied in conjunction with a force, the effects of moment and force should be found separately, and combined by the principle of superposition. If one, or both, of the ends of the beam are only partially fixed, the same additional procedure of moment distribution as used in Fig. 3 is then applied.

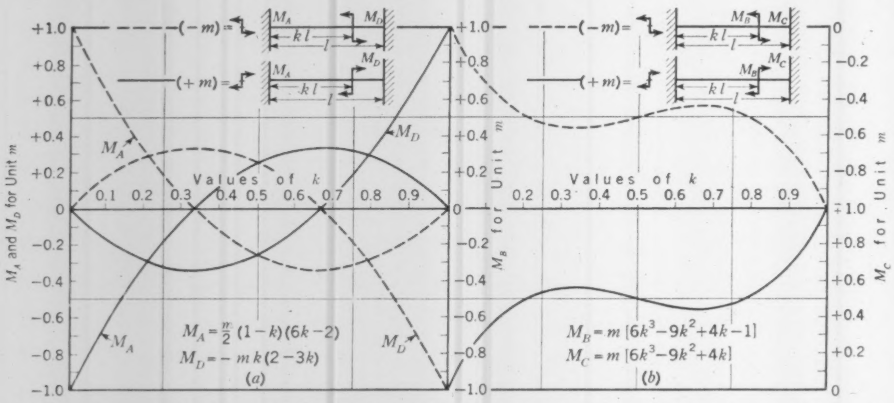


Fig. 1. Influence Lines for Bending Moment at (*a*) Left and Right Supports and (*b*) at Point of Application for a Unit Moment Applied at Any Point of Fixed Beam of Uniform Section

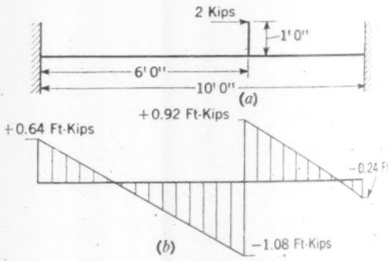

2 Kips
1' 0"
6' 0"
10' 0"
(a)
+0.92 Ft-Kips
+0.64 Ft-Kips
−0.24 Ft-Kips
(b)
−1.08 Ft-Kips

Fig. 2. A Typical Example of Torque Applied to a Fixed Beam

Horizontal Tension in Wires with Fixed Maximum Sag

By Frederick Shapiro, Jun. Am. Soc. C.E.
Designer, Madigan-Hyland, Inc., Long Island City, N.Y.

In dealing with loaded flexible bodies, such as cables and wires, it may be necessary occasionally to find the stress when the loads are unsymmetrical, the maximum sag or deflection is specified, and the horizontal and vertical distances between supports are given. As those who have had occasion to tackle this problem know, a practical exact solution can be obtained only by trial and error. The usual method is to guess at the horizontal tension, which, if known in the first place, would give the stress in the cable at once, and then correct by trial computations.

A more direct way is to locate the point of maximum sag and compute from this the horizontal tension and the vertical reactions. Of course the point of maximum sag is also unknown at first but it may be found very rapidly by trial and error, because fortunately the geometrical properties of flexible bodies give a clue to the location of this very important point.

Referring to Fig. 1, $\frac{dy}{dx}$ must pass through zero (that is, change sign) at the low point. If m is the moment about x of the loads on the left, then $Hy = V_Lx - m$, and $\frac{dy}{dx} = \frac{V_L - dm/dx}{H}$. But dm/dx equals v, where v is the sum of the loads to the left of x and does not include the load at x. Therefore, at the low point, since H is a constant, $V_L - v$ must change sign, and furthermore

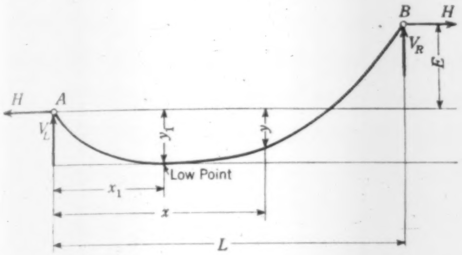


FIG. 1 NOMENCLATURE

$$V_Lx_1 - Hy_1 - m_1 = 0 \ldots\ldots\ldots\ldots [1]$$

where m_1 is the moment about the low point of the loads on its left. Taking moments about B and letting M be the moment of all the loads about B,

$$V_LL + HE - M = 0 \ldots\ldots\ldots\ldots [2]$$

Solving Eqs. 1 and 2 simultaneously,

$$V = \frac{M_1E + MY_1}{x_1E + y_1L} = \frac{m_1 + My_1/E}{x_1 + Ly_1/E} \ldots\ldots [3]$$

Therefore $\frac{m_1 + My_1/E}{x_1 + Ly_1/E} - v$ must change sign at the low point. Once the low point is located, V_L is known (Eq. 3) and H is given by

$$H = \frac{M\frac{x_1}{L} - m_1}{E\frac{x_1}{L} + y_1} \ldots\ldots\ldots\ldots [4]$$

Note that in the expression $\frac{m_1 + My_1/E}{x_1 + Ly_1/E} - v$ the known quantities are M, L, y_1, and E, and that only m_1, x_1, and v change with the assumed position of the low point. If the cable has considerable weight, the exact position of the low point may become difficult to determine, but usually an approximate location will give satisfactory results.

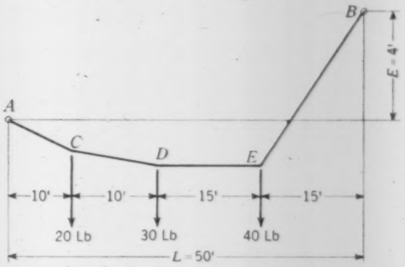


FIG. 2. ILLUSTRATIVE PROBLEM

An illustrative problem is shown in Fig. 2. A weightless wire whose supports are 50 ft apart horizontally and 4 ft vertically carries the loads shown but is not permitted to sag more than 2 ft below A. What is the least horizontal tension permissible?

$$E = 4,\ y_1 = 2,\ L = 50, \text{ and } y_1/E = 0.5$$
$$M = 20 \times 40 + 30 \times 30 + 40 \times 15 = 2{,}300 \text{ ft-lb}$$

Assuming the low point at D, then $x_1 = 20$ ft, and $m_1 = 20 \text{ lb} \times 10 \text{ ft} = 200$ ft-lb.

$$V_L = \frac{200 + 2{,}300 \times 0.5}{20 + 50 \times 0.5} = \frac{1{,}350}{45} = 30 \text{ lb}$$

To the left of the assumed point, $v = 20$ lb, but to the right, $v = 50$ lb, and $V_L - v$ changes sign. Therefore, the low point is at D, and from Eq. 4,

$$H = \frac{2{,}300 \times 0.4 - 200}{4 \times 0.4 + 2} = \frac{720}{3.6} = 200 \text{ lb}$$

Error in Discharge Measurements Due to Transverse Slope of Weir Crest

By WARREN E. WILSON, JUN. AM. SOC. C.E.
ASSISTANT PROFESSOR OF CIVIL ENGINEERING, TULANE UNIVERSITY, NEW ORLEANS, LA.

WHEN installing a weir either in the laboratory or in the field, it is desirable to know the effect of various factors on the accuracy of the instrument. In the case of a rectangular weir it is difficult to make the crest exactly horizontal. In the case of a triangular weir it is difficult to place it so that the bisector of the angle is a vertical line. If it is known that the crest is not properly oriented, it is common practice to consider the effective head to be the average head on the weir in the case of a rectangular weir, and the vertical distance from the low point of the notch to the liquid surface in the case of a triangular weir.

The method commonly used to determine the error made by using the average head on a rectangular weir is outlined in Water Supply Paper No. 200 (page 57) of the U. S. Geological Survey, by Robert E. Horton. This method requires the computation of the exact theoretical discharge by the formula,

$$Q = \frac{2CL}{5(H_2 - H_1)}(H_2^{5/2} - H_1^{5/2}) \ldots\ldots [1]$$

where H_2 is the head at one end of the weir and H_1 is the head at the other end, and L is the length of the weir crest. Obviously $\frac{H_2 - H_1}{L}$ is the slope of the crest referred to a horizontal line.

The discharge computed by Eq. 1 is then compared to that obtained by using the average head in the usual simple weir formula,

$$Q' = CLH^{3/2} \ldots\ldots\ldots\ldots [2]$$

The difference between the two discharges Q and Q' is then the error due to the slope of the crest, assuming of course that Eq. 2 properly represents the discharge for either the entire length of crest or for an elementary length of crest.

This method of computation is cumbersome and may not give good results since the differences $(H_2^{5/2} - H_1^{5/2})$ and $(H_2 - H_1)$ are small.

If we rewrite s for $\frac{H_2 - H_1}{L}$, and express H_2 and H_1 in terms of H, s, and L, Eq. 1 becomes

$$Q = \frac{2C}{5s}\left[\left(H + \frac{sL}{2}\right)^{5/2} - \left(H - \frac{sL}{2}\right)^{5/2}\right] \ldots\ldots [3]$$

Expanding this expression by means of the binomial theorem and dropping all terms after the fourth,

$$Q = CLH^{3/2} + \frac{Cs^2L^2}{32H^{1/2}} \ldots\ldots\ldots\ldots [4]$$

The second term on the right evidently represents the error due to slope of the crest.

Now since we are usually interested in the ratio of the error to the quantity measured we can get a very good approximation to this ratio by dividing the second term on the right of Eq. 4 by the first term, since for small errors the first term is very nearly the true discharge. Thus we have for the percentage of error, e,

$$e = \frac{100\ s^2L^2}{32\ H^2} \ldots\ldots\ldots\ldots\ldots\ldots [5]$$

To simplify the nomenclature let $L/H = m$. Then

$$e = 3.12\ s^2m^2 \ldots\ldots\ldots\ldots\ldots [5a]$$

If we wish to compute the permissible slope of the weir crest to insure that the error will be less than some assigned value, we need know only the largest value of m which is likely to be encountered, and the permissible percentage of error; then we may use Eq. 5a to determine the allowable maximum value of s. This equation is plotted logarithmically in Fig. 1.

For example: If the maximum value of m is 20, and 1 per cent is the maximum allowable error, we see in Fig. 1 that the slope of the weir crest should not exceed about 0.028. This is a very large slope and would easily be recognized by eye.

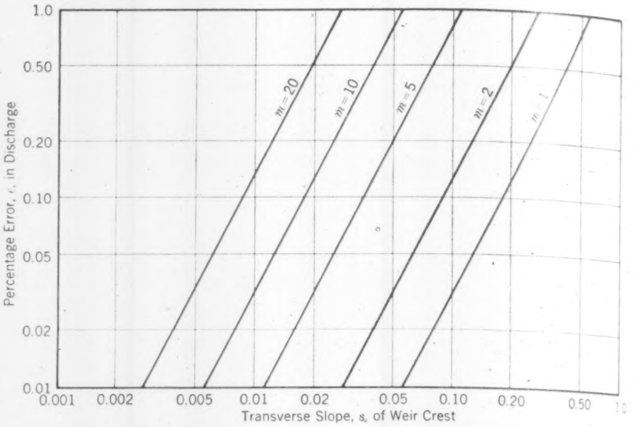


FIG. 1. PERCENTAGE OF ERROR IN DISCHARGE MEASUREMENT DUE TO TRANSVERSE SLOPE OF WEIR CREST

It is easily seen that, for ordinary values of the ratio m, any difference in slope that could not be detected by the eye would not seriously affect the work.

Equation 3 may be derived directly without reference to Eq. 1 by dividing the cross-section of the liquid above the weir crest into elementary strips of length dl along the crest, and of depth h, where h is the head at the point under consideration. Integration of the equation for the discharge through this elementary strip, across the entire length of the weir, gives Eq. 3 directly.

Treating the triangular weir from this fundamental standpoint, an equation for the percentage of error due to inclination of the bisector of the angle is found to be

$$e = 100\ \tan^2\alpha \ldots\ldots\ldots\ldots [6]$$

where α is the angle between the bisector of the notch angle and a vertical line.

Once again it is seen that the inclination must be considerable to cause an appreciable error. An error of 1 per cent would be caused by an inclination of approximately 5° 45′.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Is "Planned Education" the Answer to Social Problems?

DEAR SIR: What impresses me in reading articles such as that by Robert E. Doherty on "The Paradox of Social Progress," in the March issue, is the apparent belief that "planned education" will preserve and even enhance the highest standard of living known to man—which was the product of the individual profit motive, kept within bounds by pre-war laws, and which still exists in this country. By high standard of living I mean per capita possession of automobiles, telephones, bath tubs, radios, and other material things. In my opinion there is no man or group of men, however educated, who can produce for the general public the advantages heretofore acquired through the profit motive. We all know how difficult it is to determine what is best for ourselves, even when we have some knowledge, at least, of the problems involved. How much more difficult it is to determine what is best for millions, of whose aspirations and problems we have little knowledge.

The average high standard of living achieved by the general public is not a primary product, but is the by-product of the higher standard of living achieved by those who have been actuated by the profit motive. Through the efforts of such individuals as Carnegie in steel, Rockefeller in oil, and Ford in automobiles—all governed by the profit motive—the standard of living of the general public has been automatically raised without those individuals so planning. In other words, it is the by-product of the profit motive of those men of business genius, and of others like them.

The present depression is nothing new, except in the remedies that have prolonged it without curing it. It was originally no worse than the depressions of 1857, 1873, and 1893. Therefore, instead of passing laws to curb the profit motive and to place our standard of living in the hands of bureaucrats—no matter how well-meaning—who are consumers, not producers, we should study the remedies that ended other depressions, not only those of recent decades but those that occurred in the days of the Roman Empire and in Europe before the nineteenth century. It will be found that booms and depressions before the days of technological unemployment were astonishingly like those of recent years—the tulipmania of the early seventeenth century and the South Sea Bubble of the early eighteenth century, for instance. A study of the origin and meaning of the French phrase, "laissez faire," as applied to economics would also be illuminating.

So if we must have "planned education" in order to attain social progress, as recommended by President Doherty, let us start with a study of economic problems—from the days of the ancient Egyptians until the present—not only in Europe but also in China and Japan. No doubt the present-day "regimenter" would feel that social progress was attained early in the seventeenth century in Japan under laws that prescribed for the common people the minutest detail of everyday life, such as the shaving of beards and the wearing of clothing. The present-day denouncers of "chiselers" and "economic royalists" would enjoy similar denunciation by the prophet Amos of those who "oppress the poor" . . . and "lie upon beds of ivory." The present-day isolationist could study the effect on Japan of its isolation from 1639 to 1853 when it was ended by Commodore Perry's gunboats.

It would seem that out of so many plans to further social progress made in many lands at many times, there could be found some that would be helpful in solving our present-day problems.

Philip W. Henry, M. Am. Soc. C.E.
Consulting Engineer

New York, N.Y.

The Butterfly Valve as an Energy Dissipator

Dear Sir: The article on "Jet Deflectors for High-Dam Outlet Conduits," by Messrs. Thomas and Hamilton, in the May issue, presents an effective solution of an often troublesome problem. However, designers are frequently faced with the necessity of controlling high-velocity jets from outlet conduits under conditions that do not admit of the application of deflector structures. An example would be the outlet conduits at Chambon Dam, in the French Alps near Grenoble. The outlet conduits curve around the end of the dam and terminate at some distance below the dam in the nearly vertical rock face of the river canyon, at a height some 100 ft above the river bed. Obviously, under these conditions the construction of deflector structures such as those developed by the authors for the Tygart and Bluestone dams would not be feasible.

As a result of studies made at the hydraulic laboratory of the Ateliers Neyret-Beylier and Piccard-Pictet at Grenoble, a very effective energy dissipation, especially for the conditions at Chambon, was obtained with a partially opened butterfly valve. With the valve mounted on a horizontal axis and by careful design of its sealing edges, an excellent atomization of the discharging jet could be obtained throughout almost the entire range of operation. Stable operation, without vibration, is assured by a valve design permitting the efficient aeration of the butterfly.

It is evident that the valve may be used for controlling the discharge as well as for breaking up the jet if it is not necessary to provide for the dewatering of the conduits. The resultant saving over the cost of separate control gates and deflector structures may easily more than compensate for the high initial cost of the butterfly valve and the short enlarged conduit section at the valve necessary to prevent a large reduction in conduit capacity.

Two problems concerning model testing of hydraulic structures are emphasized in the article by Messrs. Thomas and Hamilton. The first arises in the interpretation of model test results with respect to the prototype structure. To what extent are the pressures measured on model tunnels or spillways transferable to the prototype? It seems worth while to recall that the limits of similarity between model and prototype results can be established by the use of the equations of motion and the equation of continuity. Within the range of similarity thus specified there is no question as to the transferability of results, whereas in the range beyond the limit of similarity for the quantity being investigated the model results have no meaning on the prototype. It would seem that the use of a reduced atmospheric pressure in model tests would thus be necessary only when the range of similarity was too restricted to enable the desired study of flow conditions to be made.

The second problem emphasized in the article concerns the extent of the influence of exit design on conduit pressures. Experimenters are well aware of the critical character of the exit sections of short conduits and frequently constrict this section to assure the conduit's being under pressure throughout its length. Opinion varies as to the cause of the negative pressures usually noted in short conduits—some investigators attributing them to the entrance conditions, while others, including Professor Thomas, consider the exit conditions responsible. Few studies of the problem have been made, and Professor Thomas' observations as to the marked influence of the exit section contributes to our knowledge of a slightly understood phenomenon. However, only a thorough study of the flow conditions in short pipes and conduits—for instance, under a length of about 100 diameters—could define the relative importance of the entrance and exit conditions in short tunnel and conduit design.

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Assistant Hydraulic Engineer,
National Hydraulic Laboratory,
National Bureau of Standards

Washington, D.C.

Engineers and Educators

To the Editor: Professor Finch's very interesting article on "Practicing Engineers as Educators," in the June issue, tempts me to pay tribute to the greatest educator I have ever known—the late John Galbraith, who was president of the Canadian Society of Civil Engineers (now the Engineering Institute of Canada) in 1908.

Young Galbraith started to work on a railroad in Ontario as an axman or rodman, with the idea that engineering was some sort of manual labor. One night his chief showed him a copy of Rankine's *Applied Mechanics*, and it then dawned on him with sudden force that engineering was a science.

He wrote to the University of Toronto that he wanted to take a course in civil engineering, and was disappointed, to say the least, when informed that the university had no such course. However, he got busy and, in 1877, started "The School of Practical Science" (now the Faculty of Applied Science and Engineering of the University of Toronto) to teach engineering.

For many years Galbraith was satisfied with the plain title of professor, even though he was the founder, head of the school, and principal professor. Later on he became "The Principal" and finally "The Dean." In the early days he had to teach himself at night what he taught the boys the next day. He soon built up a fine staff, starting with his friend Doctor Ellis, a chemist, and Professor Chapman, a geologist.

Many times, even recently, I have heard university presidents say they were going to revolutionize engineering education. But most, if not all, of their innovations were adopted by Galbraith in 1877.

He told us that he was not trying to turn out full-fledged engineers, but only to teach us how to study, and that he expected us to keep on studying all our lives.

He made the college term six months—from October to April—so that the boys could get work on engineering or surveying parties, which usually started out about the first of May. He knew that if they did so, they would profit very much more by the school work the next winter.

He said that it was foolish to call a man a civil engineer the day he graduated, so he insisted on the boys' having three years practical experience before coming back for a final examination, or writing an essay for the degree of C.E.

He advised us not to try to land a permanent job on graduation, but to spend several years in obtaining as varied experience as possible, in order that we might find out what we were best fitted for and would therefore like the best. Another good piece of advice was for us never to be afraid of losing our job, but always to work so that our employer would be afraid of losing us.

In addition to what he taught us, his personal kindness to me on account of my deafness (he left his platform and stood by my chair) makes me venerate his memory.

When I graduated in 1886 most "practical engineers" looked down upon university men and did not wish to employ them, but early in the nineties there was a complete change in this viewpoint and employers not only wanted graduates but they also wanted to be sure that they came from "the right" university.

For many years the Society did not grant full membership to professors. However, the professors have turned the tables and given the Society their full quota of Presidents and Honorary Members.

Once when I had my own office in New York, a man with whom I had worked before paid me a compliment by saying that, as I was a "good teacher," he would like to work for me for one year without any salary. But I did not think that I could afford to accept his kind offer, as I felt that I would have to give him too much of my time.

Any engineer should be willing to help his assistants all he can, but I sincerely hope that this country will never adopt the European system of apprentices, who work without pay, or for very little pay, for five or six years.

T. KENNARD THOMSON, M. Am. Soc. C.E.
Consulting Engineer

New York, N.Y.

[*Editor's Note:* It is interesting to note the similarity between Dr. Thomson's views on education and those of another Life Member of the Society—C. Frank Allen—who contributes the "Something to Think About" article in this issue.]

Reading with Pleasure and Profit

TO THE EDITOR: The increasing output of technical literature is making it more and more difficult for engineers and other technical men to keep pace with new developments. The necessity of reading large parts of articles to find what they contain means a loss of time which could well be spent in wider reading.

Publishing houses have increased their output of books as well as of periodicals. Societies and other organizations also issue periodicals, thus making a veritable flood of available literature. There is no need of mentioning those congenial souls, the non-readers, who can't be bothered with "new-fangled" ideas. What is said here is primarily in behalf of the many readers who try to keep up with new developments in the few minutes they can afford to devote to technical periodicals.

Whether or not it is a fact that there is less time now than formerly for the leisurely pursuit of reading, such certainly seems to be the case. At all events lack of time for reading is depriving engineers of valuable information and writers of full acknowledgment of their efforts. It is my opinion that ideas in general would be grasped more readily if presented in well-prepared summaries. Too often a reader scans the opening paragraphs of a likely looking article and sets it aside for further reading—never to pick it up again. Had the contents been briefly summarized at the beginning, the reader would probably have gotten through the article, with several ideas to the good.

It can be argued that summaries are sometimes misleading and, where provided, are read instead of the article. Be this as it may, it is a fact that many readers, failing to find a summary at the beginning or end of a fairly long paper, ignore it completely.

A summary of this kind should be a repetition of the main body itself. Obviously the pith of the subject should be presented. New facts and findings should be included as well as the author's opinion as to their worth and their advantage over known facts and methods. A summary consisting of broad generalities is of little value. It is much better to be specific.

In addition to conclusions drawn from facts, relationships in percentages and, in the case of important derivations, vital equations, tables, and graphs could be presented to advantage. I believe that to be effective the summary should be at the beginning of the article and should range from 10 to 20 per cent of the length of the article. Such a summary would be appropriate for papers exceeding a thousand words.

The advantage of the summary to the writer is what he is primarily interested in—more readers. However, the principal benefactors are, of course, the readers. Those individuals who turn pages and look at pictures may be induced to read "summaries," and once their curiosity is aroused they may be led to read further. Serious readers would not have to waste time reading articles half through before finding out that they did not contain the desired information. They would have time for more reading embracing infinitely wider fields.

My suggestion would serve to popularize writers by giving them more readers. Greater reading ease would mean broader and more diverse knowledge for the readers. From my own reading experience the scheme has decided advantages over present publication methods.

WILLIAM HOBBS, JR., Jun. Am. Soc. C.E.
Engineer, John A. Roebling's Sons Company

Trenton, N.J.

Discussion of "Symmetric and Anti-Symmetric Loadings"

TO THE EDITOR: The third problem in the article, "Symmetric and Anti-Symmetric Loadings," by Mr. Newell in the April issue of CIVIL ENGINEERING is of practical interest. It is stated that by *Das B = U Verfahren* only one sheet of calculations is necessary, against five and a half pages in Fife and Wilbur (*Theory of Statically Indeterminate Stresses*). Possibly a method (Fig. 1) involving one line of calculation for the indeterminate quantity would be of interest.

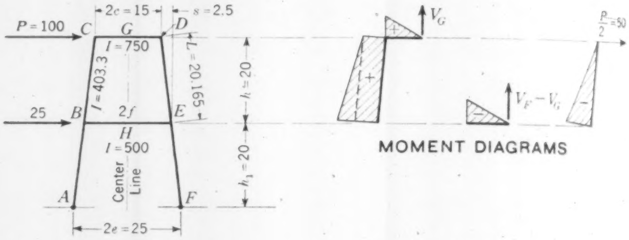


FIG. 1

Taking half the frame *BCDE* as a free body, the moment diagrams are as shown in Fig. 1. Since the tangents at *G* and *H* are parallel, the $\frac{M}{I}$ areas total zero, and we may equate the sum of the plus areas to the sum of the minus areas. Evidently $V_G + V_H = V_F$, $H = H_E$, and $V_F = (100 \times 40 + 25 \times 20) \times 1/25 = 180$.

$$V_G = \frac{\left(\frac{750}{403.3} \times \frac{100}{2} \times 20 \times \frac{20.165}{2}\right) + \left(\frac{750}{500} \times 180 \times 10 \times \frac{10}{2}\right)}{\frac{7.5 \times 7.5}{2} + \left[\frac{750}{403.3} \times 20.165 \times \left(7.5 + \frac{2.5}{2}\right)\right] + \left(\frac{750}{500} \times 10 \times \frac{10}{2}\right)} = 74.8$$

Putting this in the shape of a formula we have, for such a frame,

$$V_G = \frac{\frac{I_{CD}}{I_{CB}} \frac{P}{2} hL + \frac{I_{CD}}{I_{BE}} V_F f^2}{c^2 + \frac{I_{CD}}{I_{CB}} L\ (2c + s) + \frac{I_{CD}}{I_{BE}} f^2}$$

It would appear that *Das B = U Verfahren* is a partial statement of the theory of superposition. This method is of course merely that of graphical integration, or area moments, announced by Prof. C. E. Greene in 1873, while the method of elastic weights was announced by Prof. Otto Mohr in 1868. These two methods were devised independently, and the theorems of either may be readily derived from those of the other one.

C. M. GOODRICH, M. Am. Soc. C.E.

Walkerville, Canada

Sixty-Ninth Annual Convention

San Francisco, Calif., July 26-28, 1939

St. Francis Hotel to Be Headquarters

Opening Session and Business Meeting

WEDNESDAY—July 26, 1939—Morning

9:00 **Registration**

9:45 **Convention called to order by**

FREDERICK HALL FOWLER, *President, San Francisco Section, Am. Soc. C.E.; Consulting Civil Engineer,* San Francisco, Calif.

9:50 **Address of Welcome**

HIS HONOR, ANGELO J. ROSSI, *Mayor of the City of San Francisco,* Calif.

10:05 **Response**

D. H. SAWYER, *President, American Society of Civil Engineers; Chief, Section of Space Control, U. S. Treasury Department, Procurement Division,* Washington, D.C.

10:10 **Annual Address**

D. H. SAWYER, *President, American Society of Civil Engineers.*

Business Meeting and Luncheon Recess

Sessions of Technical Divisions

WEDNESDAY—July 26, 1939—Afternoon

HYDRAULICS AND IRRIGATION DIVISIONS

2:00 **Session opened by**

FRED C. SCOBEY, *M. Am. Soc. C.E., Chairman, Hydraulics Division, Am. Soc. C.E.; Senior Irrigation Engineer, U. S. Department of Agriculture,* Berkeley, Calif.

2:05 **Hydraulics of Sprinkling Systems for Irrigation**

J. E. CHRISTIANSEN, *Assoc. M. Am. Soc. C.E., Assistant Irrigation Engineer, College of Agriculture, University of California,* Davis, Calif.

2:25 **Discussion**

2:45 **Silt Problems of the Imperial Irrigation District Resulting from the Completion of Boulder Dam**

M. J. DOWD, *M. Am. Soc. C.E., Chief Engineer and General Superintendent, Imperial Irrigation District,* Imperial, Calif.

3:05 **Discussion**

3:30 **Design of Curves for High Velocity Open Channels**

ROBERT T. KNAPP, *M. Am. Soc. C.E., Professor, Hydraulic Engineering, California Institute of Technology,* Pasadena, Calif.

3:50 **Discussion**

4:15 **Adjournment**

WATERWAYS DIVISION

CHARLES T. LEEDS, *M. Am. Soc. C.E., Presiding*

2:00 **Protecting Chicago's Water Supply**

S. N. KARRICK, *M. Am. Soc. C.E., Captain, Corps of Engineers, U.S.A., District Engineer, Rivers and Harbors, War Department,* Chicago, Ill.

2:30 **Chicago River Controlling Works**

HORACE P. RAMEY, *M. Am. Soc. C.E., Assistant Chief Engineer, Sanitary District of Chicago,* Chicago, Ill.

3:00 **Discussion**

3:45 **The Central Valley Project**

WALKER R. YOUNG, *M. Am. Soc. C.E., Supervising Engineer, U. S. Bureau of Reclamation,* Sacramento, Calif.

4:15 **Discussion with Special Reference to the Effect on Navigation**

F. M. S. JOHNSON, *M. Am. Soc. C.E., Major, Corps of Engineers, U.S.A., Assistant U. S. Division Engineer,* San Francisco, Calif.

SOIL MECHANICS AND FOUNDATIONS DIVISION

CARLTON S. PROCTOR, *Chairman, Executive Committee, Presiding*

2:00 **Opening address by**

CARLTON S. PROCTOR, *M. Am. Soc. C.E., Chairman, Executive Committee, Soil Mechanics and Foundations Division, Consulting Engineer,* New York, N.Y.

2:10 **Photo-Elastic Analysis of Stress in Earth Masses**

ROBERT G. HENNES, *Assoc. M. Am. Soc. C.E., Assistant Professor, Civil Engineering,* and FREDERICK B. FARQUHARSON, *Assoc. M. Am. Soc. C.E., Associate Professor, Civil Engineering, University of Washington,* Seattle, Wash.

2:40 **Discussion**

3:00 **Report on Progress of Committee on Earth Dams and Embankments**

L. F. HARZA, *M. Am. Soc. C.E., Consulting Engineer and President, Harza Engineering Company,* Chicago, Ill., *Chairman.*

3:30 **Effect on Foundation of Earthquake Motion**

R. R. MARTEL, *M. Am. Soc. C.E., Professor, Structural Engineering, California Institute of Technology,* Pasadena, Calif.

4:00 **Discussion**

WEDNESDAY—July 26, 1939—Evening

7:00 Dinner and Dance at St. Francis Hotel for Members, Ladies, and Guests

Toastmaster: FREDERICK HALL FOWLER, *President, San Francisco Section, Am. Soc. C.E.*

Tickets for the dinner and dance are $3.00 each. Tickets for dancing only will be sold to Juniors and Student Chapter members at $1.00 each. Dinner dress.

Sessions of Technical Divisions

THURSDAY—July 27, 1939—Morning

SOIL MECHANICS AND FOUNDATIONS DIVISION

CARLTON S. PROCTOR, *Chairman, Executive Committee, Presiding*

9:30 **Sealing the Clay Lining of the Lagoon at Treasure Island**

CHARLES H. LEE, *M. Am. Soc. C.E., Consulting Hydraulic Engineer; Chief of Division, Water Supply and Sanitation, Department of Works, Golden Gate International Exposition*, San Francisco, Calif.

10:00 **Discussion**

10:20 **Fort Peck Dam Slide—Exploration and Reconstruction**

CLARK KITTRELL, *M. Am. Soc. C.E., Major, Corps of Engineers, U.S.A., District Engineer, Fort Peck Engineer District*, Fort Peck, Mont.

10:50 **Fort Peck Dam Slide—Tests and Analyses**

T. A. MIDDLEBROOKS, *Assoc. M. Am. Soc. C.E., Senior Engineer, Office, Chief of Engineers*, Washington, D.C.

11:20 **Discussion**

IRRIGATION DIVISION

A. GRIFFIN, *Chairman, Executive Committee, Presiding*

9:30 **Statement by A. Griffin, Chairman**

Activities of Division during last year
Current committee work
Results of 1939 membership response
General policy of Division activities.

9:45 **Concrete Linings for Irrigation Canals**

CLYDE W. WOOD, *Assoc. M. Am. Soc. C.E., President, Metropolitan Construction Company*, Los Angeles, Calif.

10:10 **Discussion**

10:30 **The Water Supply for Irrigation of the Central Valley Project, California**

COURTLANDT EATON, *M. Am. Soc. C.E., Engineer, U. S. Bureau of Reclamation*, Sacramento, Calif.

10:55 **Discussion**

11:15 **Permissible Quality of Irrigation Water**

WALTER P. KELLEY, *Professor of Agricultural Chemistry, University of California*, Berkeley, Calif.

11:40 **Discussion**

12:00 **Adjournment**

STRUCTURAL DIVISION

GLENN B. WOODRUFF, *Member, Executive Committee, Presiding*

General Subject—Earthquake Resistant Design

9:30 **Progress in Earthquake Resistant Design**

HENRY D. DEWELL, *M. Am. Soc. C.E., Consulting Civil Engineer*, San Francisco, Calif.

9:50 **Analysis of Earthquake Forces in the Design of the San Francisco–Oakland Bay Bridge**

N. C. RAAB, *M. Am. Soc. C.E., Senior Designing Engineer*, and HOWARD C. WOOD, *Assoc. M. Am. Soc. C.E., Senior Bridge Engineer, San Francisco–Oakland Bay Bridge*, San Francisco, Calif.

10:10 **Provision for Seismic Forces in the Design of the Golden Gate Bridge**

LEON S. MOISSEIFF, *M. Am. Soc. C.E., Consulting Engineer*, New York, N.Y.

10:30 **Brief Outline of Earthquake Investigations for the Pit River Bridge in California**

J. L. SAVAGE, *M. Am. Soc. C.E., Chief Designing Engineer, Bureau of Reclamation*, Denver, Colo.

10:50 **Discussion opened by**

R. R. LUKENS, *M. Am. Soc. C.E., Commander and Inspector in Charge, San Francisco Field Station, U. S. Coast and Geodetic Survey*, San Francisco, Calif.

H. M. ENGLE, *Structural Engineer, Board of Fire Underwriters of the Pacific*, San Francisco, Calif.

SCENE IN CELEBRATED YOSEMITE PARK
On Route of Special Pre-Convention Tour

SAN FRANCISCO—OAKLAND BAY BRIDGE
From Yerba Buena Island, with San Francisco in Background

THURSDAY—July 27, 1939—Afternoon and Evening

1:30 **Informal Luncheon for Members, Ladies, and Guests, Main Ballroom, California Building on Treasure Island**

Tickets for luncheon will be $1.50 each.

2:30 **Everybody Visits the Golden Gate International Exposition on Treasure Island**

6:00 **Cocktail Hour, Main Ballroom, California Building on Treasure Island**

6:45 **Informal Dinner, Main Ballroom, California Building on Treasure Island**

Tickets for the Cocktail Hour and Informal Dinner will be $2.50 each.

Sessions of Technical Divisions

FRIDAY—July 28, 1939—Morning and Afternoon

POWER DIVISION

SAMUEL B. MORRIS, *M. Am. Soc. C.E., Presiding*

SYMPOSIUM ON MASONRY DAMS

Sponsored by the following Divisions, represented by:

Construction Division	HARRY J. DEUTSCHBEIN
Irrigation Division	GLENN L. PARKER
Power Division	A. V. KARPOV
Soil Mechanics and Foundations Division	JAMES H. STRATTON
Structural Division	DUFF A. ABRAMS
Waterways Division	W. H. MCALPINE

During the last few years there have been a number of changes in design conceptions as applied to masonry dams. Probably three major influences are accountable for it:

1. The increased amount of engineering knowledge is responsible for the realization that the very simplified assumptions on which the design of dams have been based do not apply in their entirety, and that the design of safe and economical dams must be based on more refined design methods.

2. The considerable improvement in control, handling, and placing of concrete has made present-day masonry dams much more uniform, and eliminated to a large extent the uncertainties that were due in the past to non-uniform material.

3. As a result of the studies made in connection with arch dams, it has become clear that the properties of the foundations cannot be neglected if the behavior of an arch dam or a gravity dam is to be determined.

The work that is going on at present along these three major lines is being done by different men, different organizations, and often in different countries.

It would seem that all this widespread experience might well be made readily available by means of a carefully planned symposium. The immediate result would be to eliminate the theories that have no practical application at present, and to clarify the situation as to design data and theories that should be used and further developed in order to improve the design of masonry dams.

The first half of the symposium was held during the Spring Meeting on April 20 and 21, 1939, in Chattanooga, Tenn. John C. Page, M. Am. Soc. C.E., presided at these two sessions, when the following papers were delivered and discussed: "Masonry Dams—Basic Design Assumptions," by Ivan E. Houk and Kenneth B. Keener; "Design of Gravity Dams," by A. L. Alin; "Design of Arch Dams," by R. S. Lieurance; "Design of Special Dams," by C. H. Howell; "Preparation of Foundations for Masonry Dams," by Charles H. Paul and Joseph Jacobs; "Determination of Elastic Properties of Foundation Rock," by Dr. R. K. Bernhard; "Methods of Improving Foundation Rock," by James B. Hays.

9:30 **Introduction of the Chairman of the Symposium**

WILLIAM P. CREAGER, *M. Am. Soc. C.E., Chairman, Executive Committee, Power Division; Consulting Engineer*, Buffalo, N.Y.

9:35 **Opening Address**

SAMUEL B. MORRIS, *M. Am. Soc. C.E., Dean, School of Engineering, Stanford University*, Calif.

SESSION III

9:40 **Geology of Dam Sites**

IRVING B. CROSBY, *Affiliate, Am. Soc. C.E., Consulting Engineering Geologist*, Boston, Mass.

10:00 **Discussion opened by**

GEORGE D. LOUDERBACK, *Professor of Geology, University of California*, Berkeley, Calif.

F. A. NICKELL, *Geologist, U. S. Bureau of Reclamation*, Denver, Colo.

10:20 **Concrete Control**

I. L. TYLER, *Assoc. M. Am. Soc. C.E., with Pennsylvania Turnpike Commission*, Harrisburg, Pa.

10:40 **Discussion opened by**

H. F. FAULKNER, *Engineer of Concrete Control, Ruby Dam*, Rockport, Wash.

JOSEPH A. KITTS, *Assoc. M. Am. Soc. C.E., Consulting Concrete Technologist*, San Francisco, Calif.

11:00 **Construction Joints**

BYRAM W. STEELE, *Assoc. M. Am. Soc. C.E., Principal Engineer, Office, Chief of Engineers, U.S.A.*, Washington, D.C.

11:20 **Discussion opened by**

W. A. PERKINS, *M. Am. Soc. C.E., Senior Engineer of Dam Supervision, State Department of Public Works*, Sacramento, Calif.

PAUL BAUMANN, *M. Am. Soc. C.E., Senior Assistant Chief Engineer, Los Angeles County Flood Control District*, Los Angeles, Calif.

LESLIE W. STOCKER, *M. Am. Soc. C.E., Senior Civil Engineer, Public Utilities Commission, Bureau of Engineering*, San Francisco, Calif.

SESSION IV

2:00 **Testing of Dams, Dam Models and Spillways**
Part I—Structural Testing

ROY W. CARLSON, *Assoc. M. Am. Soc. C.E., Associate Professor of Civil Engineering, Massachusetts Institute of Technology*, Cambridge, Mass.

2:20 **Discussion opened by**

FRED L. PLUMMER, *M. Am. Soc. C.E., Chief Design Engineer, Cuyahoga County*, Cleveland, Ohio.

F. B. FARQUHARSON, *Assoc. M. Am. Soc. C.E., Associate Professor of Civil Engineering, University of Washington*, Seattle, Wash.

2:40 **Part II—Hydraulic Testing**

PAUL W. THOMPSON, *Jun. Am. Soc. C.E., Captain, Corps of Engineers, U.S.A., Director, U. S. Waterways Experiment Station*, Vicksburg, Miss.

3:00 **Discussion opened by**

D. P. BARNES, *Assoc. M. Am. Soc. C.E., Engineer, U. S. Bureau of Reclamation, California Institute of Technology*, Pasadena, Calif.

J. C. STEVENS, *M. Am. Soc. C.E., Consulting Hydraulic Engineer*, Portland, Ore.

3:20 **Determination of Stress by the Use of Indirect and Mathematical Methods**

J. H. A. BRAHTZ, PH.D., *Engineer, U. S. Bureau of Reclamation*, Denver, Colo.

3:40 **Discussion opened by**

CARL H. HEILBRON, JR., *Assoc. M. Am. Soc. C.E., Associate Engineer, U. S. Engineer Office*, Los Angeles, Calif.

I. M. NELIDOV, *Assoc. M. Am. Soc. C.E., Senior Engineer of Hydraulic Structure Design, State Division of Water Resources*, Sacramento, Calif.

4:00 **The Tendencies in Design and Construction of Masonry Dams**

A. V. KARPOV, *M. Am. Soc. C.E., Consulting Engineer*, Pittsburgh, Pa.

4:20 **Discussion opened by**

C. I. GRIMM, *M. Am. Soc. C.E., Head Engineer, U. S. Engineer Department, North Pacific Division*, Portland, Ore.

B. E. TORPEN, *M. Am. Soc. C.E., Principal Engineer, Corps of Engineers, U.S.A.*, Bonneville, Ore.

Sessions of Technical Divisions

FRIDAY—July 28, 1939—Morning

HYDRAULICS DIVISION

FRED C. SCOBEY, *Chairman, Executive Committee, Presiding*

9:30 **Session opened by**

FRED C. SCOBEY, *M. Am. Soc. C.E., Senior Irrigation Engineer, U. S. Department of Agriculture*, Berkeley, Calif.

9:35 **Practical Uses of the Flow and Pressure Nets in Hydraulic Investigations**

MORROUGH P. O'BRIEN, *M. Am. Soc. C.E., Professor of Mechanical Engineering, and Chairman, Department of Mechanical Engineering, University of California*, Berkeley, Calif.

10:30 **Discussion**

10:45 **Cross-Channel Floods and a Railroad**

WALTER H. KIRKBRIDE, *M. Am. Soc. C.E., Chief Engineer, Southern Pacific Company*, San Francisco, Calif.

11:15 **Discussion opened by**

FREDERICK W. PANHORST, *M. Am. Soc. C.E., Bridge Engineer, State Division of Highways*, Sacramento, Calif.

Mr. Panhorst will supplement the hydraulic experiences of the Southern Pacific with those of the Highway Division during the same disastrous flood.

11:45 **Open discussion**

12:00 **Adjournment**

SANITARY ENGINEERING DIVISION

H. W. STREETER, *Chairman, Executive Committee, Presiding*

9:30 **Technical and Esthetic Aspects of Watershed and Impounding Reservoir Sanitation**

C. A. HOLMQUIST, *Director, Division of Sanitation*, and CHARLES R. COX, *Assoc. M. Am. Soc. C.E., Chief, Bureau of Water Supply, Division of Sanitation, State Department of Health*, Albany, N.Y.

9:50 **Discussion opened by**

G. E. ARNOLD, *Assoc. M. Am. Soc. C.E., Chief Water Purification Engineer, San Francisco Water Department*, Millbrae, Calif.

R. F. GOUDEY, *M. Am. Soc. C.E., Sanitary Engineer, Bureau of Water Works and Supply*, Los Angeles, Calif.

B. S. MORROW, *Assoc. M. Am. Soc. C.E., Engineer and General Manager, Water Bureau, City of Portland*, Portland, Ore.

F. D. PYLE, *M. Am. Soc. C.E., Hydraulic Engineer, City of San Diego*, San Diego, Calif.

10:10 **Experiences in the Operation of the Chemical Treatment Plant of the Minneapolis–St. Paul Sanitary District**

GEORGE J. SCHROEPFER, *Assoc. M. Am. Soc. C.E., Chief Engineer and Superintendent, Minneapolis–St. Paul Sanitary District*, St. Paul, Minn.

10:30 **Discussion opened by**

WELLINGTON DONALDSON, *M. Am. Soc. C.E., Director, Bureau of Sewage Disposal, Department of Public Works, New York City*, New York, N.Y.

FREDRICK C. ROBERTS, JR., *Assoc. M. Am. Soc. C.E., State Sanitary Engineer, State Board of Health*, Phoenix, Ariz.

10:40 **History and Operation of the Sanitary Fill Method of Disposal of the Mixed Municipal Refuse of San Francisco**

JOHN J. CASEY, *M. Am. Soc. C.E., City Engineer*, San Francisco, Calif.

11:00 **Discussion opened by**

W. D. BINGER, *M. Am. Soc. C.E., Commissioner of Borough Works, Borough of Manhattan, City of New York*, New York, N.Y.

DR. J. C. GEIGER, *Director of Public Health, City and County of San Francisco*, San Francisco, Calif.

JEAN L. VINCENZ, *Commissioner of Public Works*, Fresno, Calif.

11:15 **Outline of the Water Supply System of San Francisco**

G. E. ARNOLD, *Assoc. M. Am. Soc. C.E., Chief Water Purification Engineer, San Francisco Water Department*, Millbrae, Calif.

11:30 **Outline of the Richmond–Sunset Sewage Treatment Plant and Other Sewage Disposal Improvements**

B. BENAS, *Assoc. M. Am. Soc. C.E., Superintendent, Richmond–Sunset Sewage Treatment Plant*, San Francisco, Calif.

FRIDAY—July 28, 1939—Afternoon

CITY PLANNING AND HIGHWAY DIVISIONS

HARLAND BARTHOLOMEW, *Chairman, Executive Committee, City Planning Division, Presiding*

2:00 **Roadside Control Through Zoning**

L. DEMING TILTON, *with California State Planning Board*, Sacramento, Calif.

2:30 **Metropolitan Highway Problems**

L. I. HEWES, *M. Am. Soc. C.E., Deputy Chief Engineer, U. S. Bureau of Public Roads*, San Francisco, Calif.

3:00 **Financial and Physical Plans**

WILLIAM J. FOX, *Assoc. M. Am. Soc. C.E., Chief Engineer, Department of Building and Safety, Los Angeles County*, Los Angeles, Calif.

3:30 **Discussion**

TECHNICAL DIVISION EXCURSIONS

1:30 **Sanitary Engineering Division Excursion to the Marina Sewage Pumping Station, the Richmond-Sunset Sewage Treatment Plant, and the Peninsular Properties of the San Francisco Water Department**

An outdoor supper will be served to those who go on this excursion.

Tickets for the supper are 75 cents each.

1:30 **Structural Division Excursion to the San Francisco–Oakland and the Golden Gate Bridges and Other Points of Interest**

The Structural Division will join the Sanitary Engineering Division at an outdoor supper.

Tickets for the supper are 75 cents each.

See page 23 in advertising section for advance registration and ticket order form. Members are urged to register and order tickets in advance.

Entertainment for the Ladies

WEDNESDAY—July 26, 1939

Morning

9:00 Registration

10:00 **Ladies will be welcome at the Opening Session of the Annual Convention**

Afternoon

1:30 **Trip around San Francisco**

3:30 Tea honoring **Mrs. D. H. Sawyer**

At the Palace of the Legion of Honor, Lincoln Park.

Evening

7:00 **Dinner and Dance at the St. Francis Hotel**

The ladies will join with the members at the dinner and dance at the St. Francis Hotel.

Tickets for the dinner are $3.00 each.

THURSDAY—July 27, 1939

1:30 The ladies will join the members at lunch at the California Building, Treasure Island

Tickets for the luncheon are $1.50 each.

2:30 The ladies will join the members in an inspection of the Golden Gate International Exposition

6:00 The ladies will join the members at a cocktail party and dinner at the California Building on Treasure Island

Tickets for the dinner are $2.50 each.

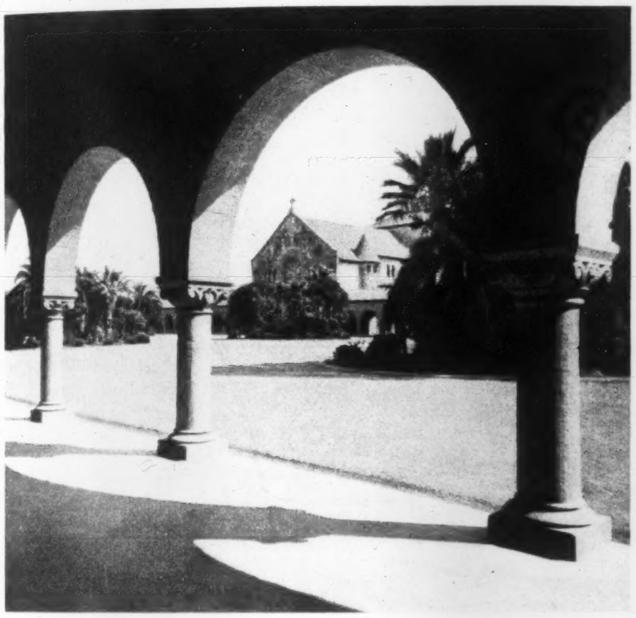
FRIDAY—July 28, 1939

10:30 Trip down the San Francisco–San Mateo Peninsula

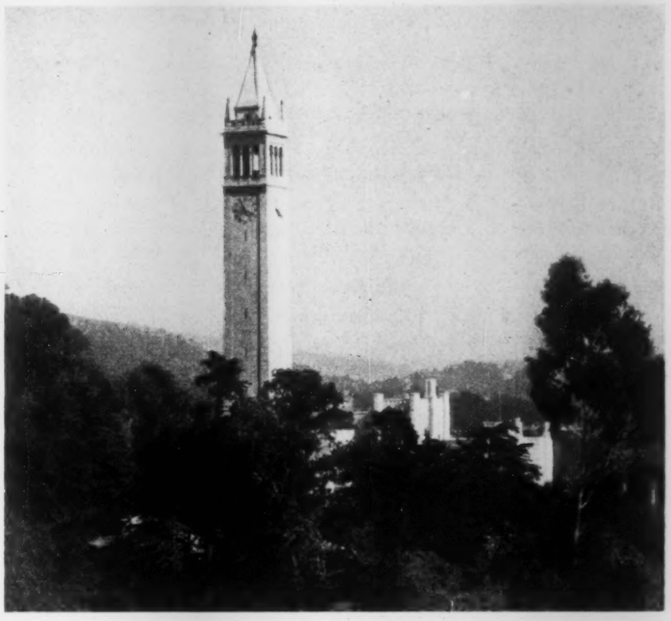
Luncheon at Allied Arts Guild. Organ Recital in the Stanford University Chapel at 2:30 p.m.

Tickets for the luncheon are 90 cents each.

Ladies are urged to use the **Special Information Desk in the Lobby of the St. Francis Hotel, maintained for their exclusive use.**



The Beautiful Chapel and Quadrangle of Stanford University



The California Monthly, Berkeley—G. Elwood Hoover, Photographer

On the Campus of the University of California at Berkeley

Places of Interest to Be Seen in and Around San Francisco

Fisherman's Wharf

Pick out your crab and have it cooked. Fish direct from the fishing boats. Fish, fishermen, boats and nets, all in a picturesque setting.

Twin Peaks

Nine hundred feet above the bay and ocean. A scenic drive that shows all of San Francisco and its surroundings.

University of California, at Berkeley, Calif.

Home of the Golden Bears.

Leland Stanford Jr. University, at Palo Alto, Calif.

Largest campus in the world.

Golden Gate Park

A one-thousand acre park reclaimed from the sand dunes. Contains the De Young Memorial Museum, Academy of Sciences, Steinhart Aquarium.

Fleishacker Park and Zoo

The "largest" swimming pool and a splendid zoo located on the shore of the Pacific Ocean.

Coit Tower on Telegraph Hill

An excellent view out the Golden Gate and down the Bay. Both bridges in wonderful settings.

See page 439 for information on special tour for eastern members to the convention, with stopovers at Lake Tahoe and Yosemite National Park enroute

Hotel Accommodations and Announcements

In order to be certain of accommodations, members are urged to make definite arrangements for rooms at least a week in advance of the Annual Convention, paying for the rooms in advance for at least part of the period for which they expect to be in San Francisco.

Hotel Rates

HOTEL	SINGLE ROOM	DOUBLE ROOM
St. Francis, Powell and Geary Streets	$4.00 up	$6.00 up
Mark Hopkins, California and Mason Streets	5.00 up	7.00 up
Sir Francis Drake, Sutter and Powell Streets	4.00 up	6.00 up
Bellevue, 505 Geary Street	3.50 up	5.00 up
Stewart, 353 Geary Street	3.00 up	4.50 up
Plaza, Post and Stockton Streets	3.00 up	4.50 up
Palace, Market and New Montgomery Streets	4.00 up	6.00 up
El Cortez, 550 Geary Street	3.50 up	4.50 up
Franciscan, 350 Geary Street	2.50 up	3.50 up
Paisley, 432 Geary Street	2.00 up	3.00 up
(without bath)	1.50 up	2.25 up

NOTE: All rooms with private bath or shower, except Hotel Paisley as noted.

The St. Francis Hotel is the Society headquarters for the Convention. All who attend the Annual Convention are requested to register immediately upon arrival. Special badges and tickets will be obtained at the time of registration.

Local Sections Conference

A conference of representatives of the 12 Local Sections in the Western Meeting Region will meet at 9:30 a.m. on Tuesday, July 25, 1939, in the St. Francis Hotel. The program will schedule topics of professional rather than technical interest. All members of the Society are welcome to participate.

Order All Tickets in Advance—See Page 23 in Advertising Section for Advance Registration Card and Ticket Order

Members who order tickets in advance will have tickets and badges awaiting them on arrival and will assist the committee greatly by giving advance information to guide it in concluding arrangements.

Information

A registration desk will be provided in the headquarters hotel to assist visiting members in securing desired information about the city. At the registration desk a card file of those in attendance will be maintained, with information as to San Francisco addresses.

Entertainment for the Ladies

Attention is directed to the entertainment provided for the ladies on Wednesday, Thursday, and Friday. It is expected that they will participate with the members in any other features of the program in which they are interested.

Invitation to Juniors and Members of Student Chapters

Juniors and members of Student Chapters are invited to participate in all the events of the Annual Convention. Particular attention is called to the special rates for the Dinner and Dance on Wednesday evening.

Junior Forum on Monday Evening, July 24, 1939

The Junior Forum of the San Francisco Section will hold its regular meeting at the Aquatic Park Casino, foot of Polk Street, San Francisco, on Monday evening, July 24, 1939, at 6:00 p.m. The Junior Forum invites all visiting members to their meeting.

Invitation to Delegates of National Council

Delegates to the Annual Convention of the National Council are cordially invited to attend any and all sessions and functions of the Society's meeting. Members of the Society are likewise invited to attend the events of the National Council on Friday and Saturday in the Hotel St. Francis.

Special Trips or Arrangements

Members who desire to take special trips are requested to consult the Registration Desk for detailed arrangements.

The program as a whole has been prepared under the direction of the Western Region Meeting Committee, composed of E. N. NOYES, *Vice-President, Am. Soc. C.E., Chairman;* and EDWARD S. BRES, CHARLES T. LEEDS, and THOMAS E. STANTON, JR., *Directors, Am. Soc. C.E.*

Please call on the Local Committee on Arrangements or on the Secretary's office for any service desired.

LOCAL COMMITTEE ON ARRANGEMENTS

GEORGE W. PRACY, *General Chairman*
FREDERICK H. FOWLER, *President, San Francisco Section*
T. J. CORWIN, JR., *Secretary-Treasurer, San Francisco Section*

N. A. BOWERS
A. J. CLEARY
W. P. DAY
C. G. HYDE
S. B. MORRIS
I. C. STEELE

CONVENTION COMMITTEES

Program

S. B. MORRIS, *Chairman*

J. S. BRIGHT
T. P. DRESSER, JR.
W. J. FOX
S. T. HARDING
C. G. HYDE
O. W. PETERSON
F. C. SCOBEY
F. G. WHITE
G. B. WOODRUFF

Treasure Island Day

I. C. STEELE, *Chairman*

J. F. BONNER
N. A. BOWERS
S. S. GORMAN
G. A. HUNT
F. F. MAUTZ
C. J. NOBMANN
J. E. RINNE
A. L. TROWBRIDGE
H. C. VENSANO
C. C. WINTER

Publicity

N. A. BOWERS, *Chairman*

B. C. GERWICK
H. L. HAEHL
G. D. WHITTLE

Finance

C. G. HYDE, *Chairman*

J. D. GALLOWAY
C. C. KENNEDY
W. H. KIRKBRIDE
J. S. LONGWELL
A. H. MARKWART
A. D. WILDER

Convention Dinners

E. M. KNAPIK, *Chairman*

A. C. BEYER
A. P. DENTON
L. A. ELSENER
E. LEVY
R. B. ROTHSCHILD, JR.
R. L. WALKER
H. C. WOOD

Reception and Registration

W. H. POPERT, *Chairman*

H. J. BRUNNIER
R. G. CONE
T. P. DRESSER, JR.
J. H. EHLERS
W. E. EMMETT
A. P. FISHER
J. J. GOULD
N. J. KENDALL
J. E. MACKIE
T. A. PERROTT
GEORGE B. PILLSBURY
M. C. POULSEN
A. V. SAPH
R. A. TUDOR
J. H. TURNER
F. P. ULRICH

Excursion

R. G. WADSWORTH, *Chairman*

G. E. ARNOLD
B. BENAS
J. R. CAHILL
T. F. CHACE
W. STAVA
D. F. STEVENS

Ladies General Committee

MRS. S. B. MORRIS, *Chairman*

MRS. JAMES I. BALLARD
MRS. PAUL BEERMANN
MRS. N. A. BOWERS
MRS. H. J. BRUNNIER
MRS. A. J. CLEARY
MRS. T. J. CORWIN, JR.
MRS. H. D. DEWELL
MRS. N. A. ECKART
MRS. T. W. ESPY
MRS. FREDERICK H. FOWLER
MISS CHLOTILDE GRUNSKY
MRS. H. H. HALL
MRS. HAROLD B. HAMMILL
MRS. S. T. HARDING
MRS. F. C. HERRMANN
MRS. C. G. HYDE
MRS. H. M. JONES
MRS. W. H. KIRKBRIDE
MRS. EDWARD M. KNAPIK
MRS. LEON H. NISHKIAN
MRS. F. W. PANHORST
MRS. W. H. POPERT
MRS. GEORGE W. PRACY
MRS. FRED C. SCOBEY
MRS. T. E. STANTON, JR.
MRS. A. L. TROWBRIDGE
MRS. H. C. VENSANO
MRS. R. G. WADSWORTH

SOCIETY AFFAIRS

Official and Semi-Official

All Members Urged to Aid in Factual Survey of Compensation

If the Society is to do anything toward the improvement of the ecnonomic status of its members, certain basic facts are needed concerning their current income as a spring-board from which to start the work. The Board of Direction has authorized a factual survey of the professional income of all its 16,000 members for the year 1938. Early this month, each member will receive a simple postcard, as reproduced here, on which he is requested to record certain data regarding his work, age, residence, grade of membership, position, and income. These cards are not to be signed nor will they be identified except by city of residence and grade of membership.

The survey is being sponsored by the Committee on Professional Objectives, of which Enoch R. Needles is chairman, and by the Committee on Salaries, of which E. P. Goodrich is chairman. An analysis of the returns will be made by the latter committee. In order that this survey may be of greatest help to the profession, every member is urged to fill out his card, immediately on receipt, and drop it in the mail.

FACTUAL SURVEY

AMERICAN SOCIETY OF CIVIL ENGINEERS

COMMITTEE ON PROFESSIONAL OBJECTIVES — COMMITTEE ON SALARIES

If the Society is to accomplish anything in respect to the improvement of the social and economic status of its own members, Headquarters must have certain facts submitted by the members FOR PURPOSE OF analyzing the present situation.

You are URGED to answer these questions and mail this card NOW.

July 1, 1939

George T. Seabury,
Secretary.

Your age ....
How many months employed in 1938 ....
Grade of Membership ....
If college graduate, what year ....
Married or Single ....
Engineering Income in 1938 $ ....
Location (City and State): ....
Do you have Civil Service Status ....

INDICATE THE NATURE OF YOUR EMPLOYMENT IN 1938

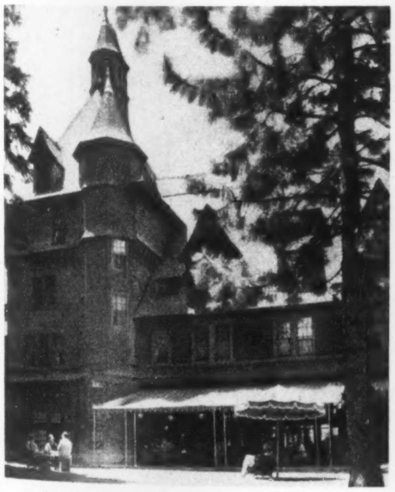
TYPE OF EMPLOYER e.g., governmental, public utility, consultant, contractor, self, etc.	**FIELD OF WORK** e.g., bridges, highways, sanitation, reclamation, etc.	**JOB FUNCTION** e.g., design, construction, surveying, research, teaching, etc.

DO NOT SIGN THIS CARD

Facsimile of the Compensation Survey Postcard

Official Convention Tour to San Francisco Meeting

As briefly announced in the June Civil Engineering, arrangements have been perfected whereby members from the Mississippi Valley and points east can pool their traveling interests to advantage in going to the Annual Convention in San Francisco. Primarily these arrangements are of a social nature, in that those traveling together are assured of pleasant company—the same sort of attraction that members find in living at a headquarters hotel, where they see their friends frequently, dine with them, and spend their odd moments to advantage in social conversation. The resulting spirit is one of friendliness, multiplying many times the enjoyment of those attending the meeting.



Tahoe Tavern, at Lake Tahoe—A Stopping Point on the Pre-Convention Tour

The special travel plans for the trip to San Francisco also provide distinct business convenience. An experienced travel director handles all the necessary details. He makes reservations en masse and thus is able to secure rates which make the trip attractive from a financial standpoint and also relieve it of much of the drudgery of individual travel.

There still remains to be mentioned one of the greatest inducements for taking the special San Francisco tour. This is the unusual opportunity of spending most of a day at Lake Tahoe and then enjoying a beautiful two-day ride over Tioga Pass and through the celebrated Yosemite Park. The schedule brings the traveler into San Francisco on the Saturday evening before the meeting, leaving three days for rest, or for taking in the World's Fair and other attractions. The time schedule calls for departure from New York on Sunday, July 16, and from Chicago the next morning.

Already sufficient reservations have been made to ensure that the party will have one or more special cars for its exclusive use. Many of those included in the party have taken previous trips of a similar nature—no better recommendation can be found. A delightful trip amidst scenic surroundings and with the best of company, all free from travel cares, is ensured. Inquiries may be addressed to Society Headquarters or directly to Leon V. Arnold, Travel Consultant, 36 Washington Square West, New York, N.Y., who will handle the trip. Reductions in rail fares have recently become effective, thus further reducing the cost of reaching the San Francisco Convention from the east.

Ross K. Tiffany Dies

Members of the Society will be grieved to learn of the death of Ross K. Tiffany, a member of the Board of Direction of the Society, which occurred suddenly on June 1 at Colville, Wash., where he had gone on a business trip. Several months ago Mr. Tiffany was injured in an automobile accident, but it was thought that he had recovered.

Ross K. Tiffany

He was born at Union, Iowa, on June 11, 1879. In 1901 he graduated from Cornell College (Iowa), receiving the degree of B.S. in civil engineering. In 1905 he was awarded the degree of C.E. by the same institution. Mr. Tiffany's early career was in railroad location and construction, including work for the St. Louis and New Orleans Railroad in Missouri and Illinois.

From 1901 to 1920 Mr. Tiffany was engaged in irrigation operation and construction in the Yakima Valley in Washington—first as engineer, and later as manager for the Washington Irrigation District; then as superintendent of irrigation, and finally as project manager for the U. S. Bureau of Reclamation in charge of the Yakima Project. In 1920 he became project manager on irrigation development in the Spokane Valley, continuing in this capacity until 1925. During this period he also served as consultant on many irrigation and drainage projects in Washington, Idaho, and Montana.

In 1925 Mr. Tiffany was appointed Washington State Hydraulic Engineer, resigning in 1929 to engage in private practice as consultant in irrigation, power, and drainage developments. He served as works manager of the Washington Emergency Relief Administration in 1933, and from 1934 until his death he was executive officer for the Washington State Planning Council, with headquarters at Olympia, Wash.

Mr. Tiffany had been active in the affairs of the Society since 1920, when he became a Member. For five years he served on the Executive Committee of the Society's Irrigation Division, and for one year was chairman of the Division. He also served as president of the Tacoma Section. In January 1938 Mr. Tiffany was elected Director of the Society from District 12, and his term would have expired in January 1941. His other professional activities included membership on the Hoover Commission on Conservation and Administration of the Public Domain. At one time he also served as president of the Washington Irrigation Institute.

Everywhere Mr. Tiffany was greatly admired. Not only did his fine mind and his outstanding ability make him eminent, but his warm and genial friendliness drew to him a wide circle of admiring friends. He was a splendid man and an excellent engineer

British American Engineering Congress

Comprehensive Program Planned for New York Covering One Week, September 5–9

A number of innovations mark the attractive arrangements that have been made for the Society's Fall Meeting. First, it is to be a joint meeting, at which various branches of engineering will be represented; the American Society of Mechanical Engineers and this Society have arranged corresponding programs which will dovetail. Even more important is the international flavor, to be supplied by the large number of visitors expected from both Great Britain and Canada. The former will come under the leadership of the Institution of Civil Engineers, and the latter sponsored by the Engineering Institute of Canada. Of course, the New York World's Fair close at hand was one of the prime considerations in the successful planning of this meeting.

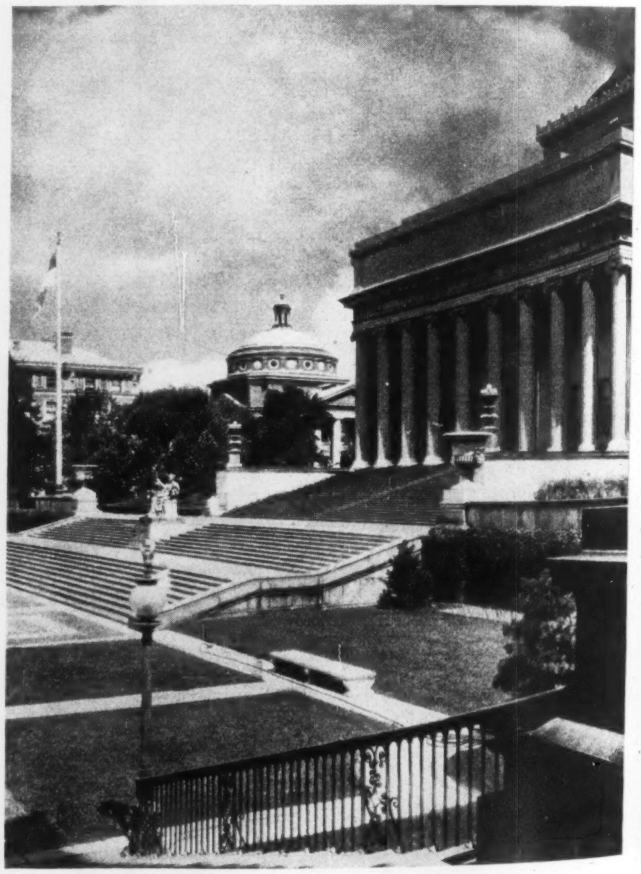
But the meeting has other unusual features. The necessity for joint arrangements is responsible for the unusually early date, immediately following Labor Day. This is not without its advantages, since it brings the meeting within easy reach of those who can arrange for their summer vacation period in early September. Society records indicate that not since 1874 has an Annual Convention been held in New York City, and a Fall Meeting has never been held there, so in this respect also, a long-standing precedent is being broken. Finally, the arrangement for the civil engineering meetings themselves is unusual, in that they are not to be held at Society Headquarters but at Columbia University. There also, in the college dormitories, will be the living quarters for delegates and visitors.

Because of the advance in the time of the meeting, all programs and announcements are similarly advanced. Hence the details usually included in the September issue are being given here so that members will have sufficient time to make their plans. The official program will appear in the August number.

Details of the meeting, including the World's Fair, technical, social, and sight-seeing features, can be readily gained from the accompanying condensed schedule. In their general features, the engineering sessions are marked by a combined meeting on the first morning, Tuesday; three simultaneous technical sessions on both Wednesday and Thursday; and a closing joint session with the mechanical group on Friday. Afternoons and evenings are reserved for excursions, sightseeing, and more formal social events.

Special Events for Ladies

A word as to the ladies' program—provisions have been made for the profitable expenditure of time both mornings and afternoons. On Tuesday afternoon, the entire party—including civil and mechanical engineers from England, Canada, and the United States—will embark on a boat excursion. The trip will cover the Hudson River south of the George Washington Bridge, New York Harbor as far as Staten Island, and the East River, up to the World's Fair, where the evening will be spent. A variety of local trips is planned for the ladies on Wednesday, including a tea in the afternoon, and culminating in a formal banquet in the evening. Thursday takes



Vista of Columbia University Campus—Low Memorial Library in Foreground

Tentative Skeleton Program, British American Engineering Congress, New York, N.Y., September 5–9, 1939

	American Society of Civil Engineers Institution of Civil Engineers Engineering Institute of Canada	American Society of Mechanical Engineers Institution of Mechanical Engineers	Ladies All Groups
Time	Headquarters: Columbia Univ.	Headquarters: Eng. Soc. Bldg.	
Tuesday Sept. 5, 1939 Morning	General Meeting on Professional Status of the Civil Engineer	Railroad session	Visit to Museum of City of New York and American Museum of Natural History
Afternoon	Boat Excursion about New York harbor, thence to World's Fair by boat. Luncheon and tea aboard boat		With men on boat excursion and at World's Fair
Evening	At World's Fair		With men at World's Fair
Wednesday Sept. 6, 1939 Morning	Sessions on: (1) Construction Methods (2) Sanitation and Water Supply (3) Highways	Railroad session	(1) Shopping tour with luncheon at Women's Republican Club (2) Visit to Morgan Library with luncheon at Engineering Woman's Club (3) Visit to World's Fair with luncheon at World's Fair
Luncheon	At Faculty Club, Columbia University or elsewhere	Pennsylvania Hotel	
Afternoon	Sessions on: (1) Soil Mechanics (2) Landing Fields (3) City Planning and Parkways	Railroad exhibits at World's Fair	Tea at Columbia University Tea at Pennsylvania Hotel
Evening	Banquet and Dance, Hotel Waldorf-Astoria		At Waldorf-Astoria
Thursday Sept. 7, 1939 Morning	Sessions on: (1) Soil Mechanics (2) Structural Design (3) Use of Electricity	Highway Transport session	All-day sightseeing trip, including visit to West Point
Luncheon	At Faculty Club, Columbia University, or elsewhere	Pennsylvania Hotel	Luncheon at Bear Mountain Inn
Afternoon	Inspection Trips and World's Fair	Motor exhibits at World's Fair	Tea at Stevens Institute, Hoboken
Evening	Entertainment at McMillin Theater, Columbia University		With men at Columbia University
Friday Sept. 8, 1939 9:00 a.m.		Transatlantic airplane session	
11:00 a.m.	Closing session at World's Fair		With men at closing session
Luncheon	At World's Fair, or as desired	At World's Fair, or as desired	With men of their party
Afternoon	Visit to North Beach Airport or World's Fair, as desired		With men of their party
Evening	As desired	As desired	With men of their party
Saturday Sept. 9, 1939	Departure of British Civil Engineering Group for Washington, D.C.	Departure of British Mechanical Group for Schenectady, N.Y.	

the women's group out of the city, by bus to West Point, returning on the New Jersey side, in time for a joint evening's entertainment at Columbia University. On the closing day, Friday, the ladies will participate with the men in all events, including the final session, luncheon, and attendance at the World's Fair.

It is expected that many of those attending from the United States and Canada will come by automobile, and accordingly arrangements have been planned to provide for this mode of travel. Congestion at New York hotels over a popular week-end will be avoided by the generous facilities of Columbia University. There, members and guests with their entire families will find commodious accommodations at minimum cost. Plans for the convenient parking of automobiles are also being perfected. This locality can be easily reached from all points of the compass, with negligible interference from city traffic, by using the various tunnels and bridges together with the West Side Elevated Highway, all monuments to the civil engineer's genius.

Attractive Rail Tickets Offered

The location of Columbia University is also convenient for those who travel by rail. It can be reached easily by subway from the Pennsylvania Station, or by a brief taxicab ride from the 125th Street Station of the New York Central and New Haven roads. Speaking of rail travel, it should be emphasized again that the Fall Meeting has been planned in full harmony with the Convention schedule for San Francisco at the end of July. Here are two outstanding meetings, characterized by two spectacular world's fairs. The railroads have recognized the possibilities inherent in such a combination and have listed most attractive fares, which permit of a round trip from any point in the country to include both objectives. No member contemplating attendance at either fair should overlook this opportunity of attending both on the same ticket, and at the same time of being present at two splendid Society meetings.

For the visitors from Europe, the program will begin one day earlier. The liner *Samaria*, bringing the British delegations, will reach Boston on Sunday morning. After entertainment by local groups, the members of the British party will entrain for New York, where they will spend all of Labor Day in sightseeing and other informal activities.

Inclusive Rates Reduce Expense

By handling room reservations and social events for such a large meeting in the standardized form as outlined, many economies are possible. The committee has therefore arranged to offer an upset price to include room, registration, trips, and all official social events. The economies thus obtained make it possible to set an overall price for the four-day visit which is within the reach of all pocketbooks. Of course, individual tickets for every event will be available for those who cannot take advantage of the inclusive rate. For time schedules, meeting topics, names of distinguished authors including outstanding members of the British Institutions of Civil and Mechanical Engineers as well as the Engineering Institute of Canada, and all other details, reference should be made to the official program which will appear in the next or August issue of Civil Engineering.

Southern Region Local Sections Conference

Fourteen Sections Send Representatives to Chattanooga

PRECEDING by one day the Spring Meeting of the Society, the Southern Region Local Sections Conference met in Chattanooga on Tuesday, April 18. Under the leadership of James W. Follin, chairman of the Society's Committee on Local Sections, the conference wrestled during the day earnestly and with enthusiasm for answers to the questions: "How Can Local Sections Be Made of Greatest Benefit to the Profession?" and "What Duties and Functions May Properly Be Turned Over to Local Sections?"

After a warm welcome to Chattanooga by Lee G. Warren, president of the Tennessee Valley Section, the conference plunged into a discussion of ways in which Juniors may be used in the work of a Local Section.

JUNIOR PARTICIPATION

Speaking from his observations as a director of the Alabama Section, Roy S. Garrett stated:

"During the first five years out of college, although he may be following the engineering profession, a Junior is usually employed in sub-professional work—menial labor in most cases—which is in reality serving an apprenticeship. He is usually paid very little money, not much more than common labor, in very few instances as much as skilled labor. Never has he the authority that is given to a first-class section boss. Having spent a large sum of money to acquire the highest education possible, he, after several years, has advanced only a few dollars a month in salary and very little in prestige, and is likely to become completely disillusioned about his chosen profession. It is a difficult undertaking to impress on him the great advantages and opportunities offered by association and cooperation in the Society, which has such high ideals of ethics, standards, and qualifications for membership.

"In our state, where there are about 125 members of the Society, only half of the forty or fifty who are participating members of the Local Section take an active interest in its affairs. Our comparatively few Juniors are scattered from one end of the state to the other. Ninety per cent of the Corporate Members are forty years of age and older; the Juniors are between twenty and thirty.

"Nevertheless, we plan to invite each member of the senior class of our two engineering colleges to a banquet, to be held about ten days or two weeks before school is out, as guests of ten or fifteen of our most active older members. Special effort is to be made to require the Juniors to take active interest in our Local Section work by contributing papers—at least one—at every other meeting. In this way, through close comradeship with the younger members, we hope to develop a stronger Section."

In the District of Columbia Section, the large number of Juniors have organized themselves into a forum for self-improvement. Benjamin E. Jones, acting secretary of the Section, said that the Junior Forum in Washington has been operating successfully for two years. Its monthly meetings are managed and arranged entirely by the Juniors through a rotating committee of three appointed for three months each, with terms of office staggered. The committee arranges for a speaker, ordinarily a Junior, who usually tells of his own line of work, although occasionally an outside speaker is invited. In general, the officers of the forum function as do the officers of the Local Section. The entertainment committee almost always arranges some small refreshment at the end of the meeting. On occasion, a social function is held, and several trips of inspection are arranged each year.

It has been the experience of the District of Columbia Junior Forum that its members are improved by taking part in its management; by preparing and presenting papers; by learning what other engineers of their own age are doing in other fields; and by broadening their acquaintance among the many engineers in the District of Columbia. Mr. Jones said, "Ten or fifteen Juniors are enough for a successful forum. It prepares them to take part in the management of the Local Section."

In discussing what a Local Section can do for its Juniors, Prof. Scott B. Lilly, member of the Society's Committee on Juniors, gave a summary of the report of that committee which was reproduced in full in the June issue of CIVIL ENGINEERING on page 376. H. F. Fruend reported that 33 of the 59 Knoxville Juniors of the Tennessee Valley Section had voted in favor of a Junior forum. J. I. Perrey, chairman of the Chattanooga Sub-Section said, "We have a large percentage of Juniors, but rather than make a special organization for them, we try to give them a part in Section activities. We have put them on committees. Some of the committees of this Convention are headed by Juniors. A Junior heads our Sub-Section's monthly publication and several others work on it. The Juniors are anxious to do things, and when given this opportunity, they feel they are doing something for the Society." Professor Focht, secretary of the Texas Section, stated that that Section is making plans for a Junior forum.

ENFORCEMENT OF REGISTRATION LAWS LOCALLY

Speaking on "Enforcement of Registration Laws Locally," T. F. Boltz, president of the West Virginia Section, said: "We all know that the enforcement of registration laws depends on two things: first, the law must be right and just both to the engineer and to those he serves; and second, the law must have favorable popular opinion behind it."

He stated that the law in West Virginia is the result of amending again and again the early law as passed by the legislature in the early twenties. It now has teeth in it; anyone calling himself an engineer had better be registered, or face a fine of not less than $100 nor more than $500 with a vacation of three months in jail.

"The enforcement divides itself into two phases: on public work and on private work. On public work, enforcement has been easily obtained, usually without resort to court action. In private work, the solution has not been so easy. Since some corporations employing engineers have not insisted on their engineers being registered, an attempt has been made to clarify this situation through the Attorney General. His rulings are: 'If a corporation is engaged in the business of designing and constructing buildings and equipment for use of its employees, which . . . involve safeguarding life, health, or property and require the application of engineering principles . . . then the act . . . can be performed only by registered engineers and if the engineers so employed are not registered then the corporation is practicing engineering in violation of the law.'

"Another question we have referred to the Attorney General is this: 'Is it permissible under the law for a city or county to employ a registered mining engineer to design and supervise the construction of streets and sewers, such work as is usually performed by a civil engineer?' Briefly, the Attorney General finds that as long as the engineer is registered in any branch of engineering he is entitled to practice in that or any other of the classifications of professional engineering.

"The enforcement of a registration law is easy, particularly because the registered engineers are jealous of their professional standing. West Virginia has a good law but from time to time attempts are to be made to improve it."

Opening the discussion, Gerald Keith, acting secretary of the Florida Section, said that for the past five years there had been no legal proceedings against any registered professional engineer or non-registered person practicing as an engineer in Florida, but that the Registration Board of five men has brought many cases of the employment of non-registered engineers to the attention of corporations employing them. Some smaller towns in Florida have a form of government in which a city manager is appointed, frequently a man with engineering background but unregistered. The troublesome question often comes up, Is the city manager signing, as city manager, some things that ought to be signed by an engineer? Mr. Keith mentioned the desirability of placing registration on a national basis so that a registrant qualified in one state can qualify in all states.

Several other phases of registration were discussed by Prof. E. R. Cary, vice-president of the South Carolina Section, Col. A. C. Polk, of the Alabama Section, and Prof. W. A. Coolidge, of the Nashville Section. For the record it was announced that the Maryland legislature had passed a registration law (signed by the Governor on May 27, 1939) and that a registration law for the District of Columbia is before Congress.

MAKING SALARY SCHEDULES EFFECTIVE LOCALLY

In introducing the topic of making the Society's salary schedule effective locally, Hal Hale, representing the Georgia Section, advocated taking two steps: First, register every engineer who holds an engineering position; and, second, convince the public that engineers, as a specially trained technical group of men, are entitled to an adequate compensation. "No matter how long we struggle for salary sufficiency within the profession," he said, "no salary schedule we adopt will ever become effective until we are able to sell the public on the fairness and validity of that schedule by our own persuasive ability."

In a discussion prepared by President Frank Herrmann, of the Oklahoma Section, which appears elsewhere in this issue, he pleaded for more active interest in the Society by its members; pointed out the necessity for political assistance in establishing salaries for civil engineering positions in public service; and asked the cooperation of employers of engineers in private organizations. Colonel Polk stated that the Alabama Section has been asked to cooperate with the Civil Service Board in setting up the specifications and appropriate salaries for the positions to be held under the recently enacted State Civil Service Law. Both Mr. Keith and Victor J. Bedell, secretary-treasurer of the Louisiana Section, argued that the Local Sections must educate newspaper copy writers and the general public concerning just what an engineer is and the part he is called upon to take in the life of his community. Does the average citizen believe that an engineer runs an engine and that a civil engineer is an engineer who removes his hat in the presence of a lady? Further discussion developed the viewpoint that a salary schedule simple enough to admit of no misinterpretation must be developed by the Society, and that thereupon Local Sections can be most effective in establishing such a schedule locally.

Local Publicity

"To be successful in metropolitan centers with a program of local publicity for civil engineers and their work, entails hard work," said G. J. Requardt, former president of the Maryland Section. Referring to Baltimore newspapers as the publicity medium, he stated that these papers are fully staffed with professional reporters who have big-city viewpoints on the news value of any copy obtained by them or sent in to them. They will always print notices of meetings and the name and title of the speaker; and if a well-known man comes from out of town, they will give a good write-up of him. A reporter should be invited to Section meetings and asked to participate in the refreshments. A member of the Section should be assigned to him to see that he meets the speaker. A well-written, brief summary of a speaker's remarks prepared ahead of the meeting and sent to the paper saves the reporter's and rewrite editor's time. The placement of civil engineers on civic boards and committees should be sponsored by Local Sections and will receive attention by papers. Technical write-ups of local improvements featuring the civil engineer responsible for the work must be handled tactfully. Papers are glad to print items concerning honors conferred upon, or prizes won by, local engineers, and those concerning winners of competitions open to Juniors and members of Student Chapters. Obituary notices must be handled with great speed. Sponsorship of local improvements by Local Sections is difficult and dangerous. "Usually the Section will not be of a single mind on any question of civic improvements and if a vote is forced, some members will resent such action. A small committee, definitely appointed for the purpose, can study the problem and more properly take a position than can the Section. A publicity program must be a continuous one rather than spasmodic," he said.

In his discussion, President William E. Elam, of the Mid-South Section, emphasized that the Local Section is a powerful agency through which engineers can benefit their respective localities and states by interpreting to the citizens their functions as engineers and by establishing their ability to serve the public in various ways.

An important essential of handling publicity is to find a qualified person to do it. The Tennessee Valley Section found such a person in Mrs. Barksdale, wife of John F. Barksdale, Assoc. M. Am. Soc. C.E. She told the Conference that publicity begins with the engineer himself. "Engineers, I found, are reticent about talking; they are very modest." She said engineers must take time to talk about their work and explain it so that reporters who know nothing about engineering can understand. She has interested younger engineers in writing stories about engineering, acceptable to reporters and editors for newspaper use, and has prepared and presented radio broadcasts, with the result that a considerable public interest in civil engineers has been built up in Tennessee.

Merit Systems for Civil Engineers in Public Service

More and more men in the civil engineering ranks are being employed on public work and it is becoming increasingly important to get qualified men for these positions. The Board of Direction has recorded itself as favoring the merit system instead of the spoils system for civil engineers in public employ. Representing the Virginia Section, Vice-President E. S. Thomas presented the topic, "The Establishment of Civil Service or Merit System for Civil Engineers in City and State Employ." He said that the engineering profession ought to be for a properly operated civil service system, but in Virginia any program the object of which is to bring all engineers in city and state employ under the operation of such a system would appear to be a backward movement; it would have the tendency to curtail individual initiative, and would not meet with favor.

On the other hand, Mr. Garrett said that Alabama this year had inaugurated a merit system and that the Alabama Section favored it. The Alabama Highway Department is one of the largest employers in the state of both engineers and labor. Mr. Boltz pointed out that a merit system can be removed from the whims of political groups by amending a state's constitution to make permanent provision for it.

Local Committees on Professional Objectives

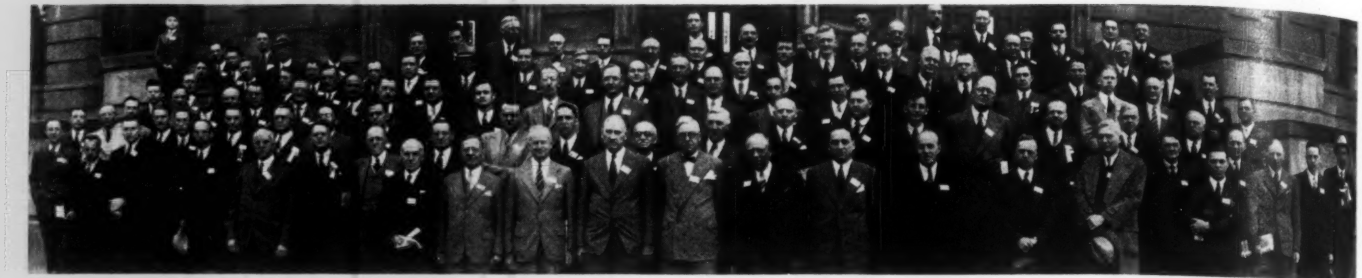
One of the objectives of the Society is "the professional improvement of its members." Within the year the Board has appointed a Society Committee on Professional Objectives which in turn has sponsored the appointment of a Local Committee on Professional Objectives in each Local Section. To date 41 Sections (including one Sub-Section) have appointed such committees, with a total personnel of 185 members. Speaking of the field and function of these local committees, John A. Focht, secretary of the Texas Section, said:

"During the depression the Founder Societies decided that something should be done to enhance the professional status of the engineer, and a conference resulted in the formation of Engineers' Council for Professional Development, to coordinate and promote efforts and aspirations devoted toward higher professional standards of education and practice, greater solidarity of the profession, and greater effectiveness in dealing with technical, social, and economic problems. Committees were appointed and studies made. It was felt that the major opportunity for improvement of the professional status of the engineer was in improving the educational qualifications of the younger engineer.

"Is the complaint justified that older engineers show a lack of interest in the young graduate? Our students have Student Chapters, faculty advisers, and contact members, but after graduation the young engineer is turned loose with but little supervision and advice. How many times have we seen a good draftsman kept at a drafting table and never given an opportunity to get other experience? Inspectors on paving jobs too frequently do such satisfactory work that they are transferred from one job to another at the same rank and salary. Engineers who employ young men can help to give them the experience needed for obtaining a professional license and the responsibility required for advancement to Corporate Membership in the Society.

"Our Texas Committee on Professional Objectives has a distinctive badge for use at its meetings for both students and Juniors, and a special committee sees to it that the Juniors and students are introduced to all the members of the Section and are drawn into the circles of conversation. We have tried to give Juniors a place on every committee. Plans are being discussed for a Junior forum in Texas that will enable the widely scattered Juniors to participate in them. This committee is preparing to give advice and guidance to high school graduates concerning their study of engineering; to encourage or discourage those who have dropped out of engineering college to complete their education; to stimulate engineering schools; to encourage and welcome engineering students and Juniors to attend Section meetings; to find work for the Juniors to do in Section affairs; to assist Juniors in having their abilities recognized; and to assist them to obtain opportunities for increased experience."

The Knoxville Sub-Section of the Tennessee Valley Section submitted a searching questionnaire to its 178 members. Mr. Fruend



A GROUP AT THE 1939 SPRING MEETING, CHATTANOOGA

made a report of the answers received from the 27 Juniors and 71 Corporate Members who replied. Based on the replies received, he said that only 4 per cent were satisfied with the present status of engineers and that 86 per cent desired the Society to take active and aggressive interest in the economic status of all its members. While only one person replying held a position requiring him to have a professional license, 60 per cent favored compulsory registration of all engineers regardless of type of employment, and 50 per cent were willing to pay increased dues if necessary to carry on legal action to enforce registration. Approximately 80 per cent were opposed to unionization in any but sub-professional grades, and 60 per cent regarded union membership as a bar to advancement to important engineering positions. Eighty per cent believed the Society should help the young engineer find his place and not leave this field open to other associations formed for this specific purpose. About 70 per cent opposed the raising of standards for admission to the Society. Other questions submitted resulted in less positive opinion. The Knoxville Sub-Section has made certain recommendations to the Committee on Professional Objectives.

LOCAL SECTION ADMINISTRATION

"In administering the Louisiana Section," said Victor J. Bedell, secretary, "its officers are guided first by objectives which have been set up by the Society for all Local Sections: the advancement of engineering knowledge and practice; the cultivation of friendly relations with all engineers; the maintenance of high professional standards; and cooperation with other engineering societies to promote the general welfare of the Society and the profession."

He stated that a Local Section, by its interest in Student Chapters, can influence engineering schools to provide proper teaching staff and facilities. It can encourage the Chapters in their work and, through student inspection trips sponsored by the Section, aid them to become better acquainted with actual engineering problems, with their practical solution, and with the engineers in charge of them. It can encourage members of Student Chapters to become Juniors of the Society. A Section should maintain a program of technical lectures, papers, and inspection trips to be of interest to, and participated in, by members of the Section in all grades.

Every Section should see to it that its members live and work in accordance with the Code of Ethics. There is a tendency among human beings to criticize carelessly the work of others, a tendency just as evident in the engineering profession as in other lines of endeavor. Such unfair, unjust, and unconsidered criticism will result in financial loss to the owner of the project and an enormous loss of prestige to the whole profession. Engineering failures, especially of public works, should be carefully investigated by the Section to place the responsibility of the failure accurately. It should be the duty of a Section to use its influence to have only competent men appointed to state registration boards and permit only qualified engineers to acquire a license.

The Louisiana Section holds joint meetings with Sections of the other national societies and with the Louisiana Engineering Society. Student Chapters at Tulane and Louisiana State University report to the Louisiana Section and form a very interesting part of the Section's program. A scholarship is maintained by the Section at both of these schools, and a prize of a Junior membership in the Society goes annually to an outstanding graduating member of each Chapter. The Secretary writes to each new member of the Society and to those moving into Louisiana. Usually some member also calls on such engineers personally. A complete personal record of each engineer out of employment is maintained, and the Section's employment bureau is advised of projects which require the employment of engineers. The Section believes this placement service to be of particular value to the Juniors. Cordial relations with the Louisiana press have helped to obtain press notices of all Section meetings. Once a year an open meeting for wives and guests is held, the main attraction being an illustrated lecture on a subject of general interest. The Ladies' Auxiliary of the Louisiana Engineering Society maintains an engineering scholarship at Tulane and at Louisiana State University.

A Local Section's success depends on the interest of its leaders. The best men are often the busiest but when properly approached will not be too busy to promote the welfare of their associates. When it is put to them on this basis, they will usually accept the responsibility and carry it out with credit to themselves and success to the Society.

SUMMER CONFERENCE IN SAN FRANCISCO

On Tuesday, July 25, during the Annual Convention of the Society at San Francisco, a similar conference is to be held of the representatives of the Western Local Sections—Arizona, Colorado, Los Angeles, New Mexico, Oregon, Sacramento, San Diego, San Francisco, Seattle, Spokane, Tacoma, Utah, and Wyoming. The Committee on Local Sections proposes a similar agenda of subjects for the San Francisco Conference.

How Can Local Sections Be of Greatest Benefit to the Profession?

Summary of Address Before the Local Section Conference, at Chattanooga, Tenn., April 18, 1939

By DONALD H. SAWYER, PRESIDENT, AM. SOC. C.E.

AS THE Society increased in numbers, local members felt the need of some local organization that could speak more intimately of their problems than was possible through the Board of Direction. With doubts and with perplexity about the wisdom of the decision, the formation of local bodies—little boards of directors—was authorized. On behalf of all members of the Society the Board of Direction speaks; the officers and committees of Local Sections speak in behalf of those on their roster.

The wisdom of the movement was quickly demonstrated and there has followed a series of events which have justified that original decision. As soon as local officers became more conscious of the opportunities they had of working in behalf of their own members, Local Sections were extended to embrace the entire membership of the Society. After a considerable debate on the part of the Board of Direction, a Field Secretary was appointed to give continuous study and help to these local groups of members.

If the Local Section idea was sound, as apparently has been demonstrated, it was worthy of further money from the Society in order to increase the service the Sections could give to their members. So now a plan has been put into effect by which, on a formula basis, uniformly applicable, each Section gets more money from Headquarters than it did before. It remains to be proved that Section officers are making the wisest expenditure not only of their own funds, but also of those that are received from Society Headquarters; and that this financial undertaking is a wise one. I am encouraged to believe that as the Sections realize they have enlarged resources available, members can pin their faith on the officers who have charge of the disbursement of these increased sums.

A further belief on the part of the Board of Direction, that the officers of a few Sections, by meeting together several times a year, would add to the effectiveness of their service to their members, has encouraged the continuation of Local Section Conferences. The more time we spend in telling what we are doing and the more these new ideas can be inculcated and made an integral part of local programs, the more effective will our local service become.

A Committee on Public Information, national in its scope, has been at work and has developed a program intimate and direct enough to be applicable to each Local Section. It has sponsored the monthly sheet called "Headlines" which goes to local officers. I do not know how Section officers can read their copies of this publication month after month without being stimulated to get some of their newspaper publicity reproduced in it. If you are proud of your Local Section, if you are proud of the work you are doing in your town, you have news of sufficient value to get into your local papers.

The Board of Direction cannot go much further than to provide the facilities that I have named. If you feel your responsibilities, and make use of the tools that the Society makes available to you, if you have strong committees and strong officers, if you bring in the young fellows, if you have frequent meetings seasoned with a certain amount of entertainment, if you are determined to make your Section of real benefit to the members who support it, you will be surprised at the loyalty that will assist your efforts, and how willing the Board will be to give as much further aid as is possible.

What can we do, you will ask? Do not disparage the value of increasing your acquaintance, broadening your contacts, and finding out the mental processes of the other fellow. Induct yourselves into civic movements for which your past experience, your mental processes, and your trustworthiness equip you. Many of the planning commissions of cities, counties, and states have no engineer on them. How many engineers are there in Congress; how many governors or mayors are there? There are very few. Are engineers unfitted for public office entirely aside from their professional work? I don't believe it. Is there distrust of the judgment of engineers in the minds of the people of your town? I don't think so. Have engineers made successes of their own work in your town? Our towns are full of successful engineers. The engineer is derelict in not promoting himself into these opportunities. Engineers should share in the honors that come from administrative and community work.

Some will say, "I haven't the time." In answer I will say that if you do not find the time to meet people, to get better acquainted, to take part in the activities of your community life, you are overlooking a wonderful opportunity for attaining greater stature and greater capacity. The man that leads a solitary, hermit life may turn out the finest technical work that can be done, but if he has that ability and does not know where to sell it, of what great value is it to him?

Be proud of your profession, proud of your Society, proud of your Local Section. Whatever success you attain in rendering services to your members, if publicized, can add to the services provided by another Section elsewhere. Also, it will help to build up in your own community a recognition of the fact that engineers have a peculiarly valuable talent for rendering public service.

Method of Making Society's Salary Schedule Effective Locally

Presented at the Local Section Conference at Chattanooga, Tenn., April, 18, 1939

By FRANK HERRMANN, PRESIDENT OF THE OKLAHOMA SECTION
OFFICE ENGINEER AND DESIGNER, OKLAHOMA CITY WATER DEPARTMENT, OKLAHOMA CITY, OKLA.

SUCCESS may be interpreted in many ways. An engineer who truly loves his work will feel that he is successful if he is assigned important work, such as he has dreamed of, and is allowed to carry it to a successful completion. In such a case the opportunity to do the work is more important to him than the financial remuneration. Other engineers feel that they are successful if they can find interesting employment where they can settle down to the uninterrupted enjoyment of home, family, and friends, and become worthy and respected members of their community, church, and preferred clubs and societies. In this latter case they will accept a low financial return as long as the continuity and peacefulness of their method of living is undisturbed. There are other definitions of success and they may be linked to reasons why low engineering earnings continue and are tolerated.

Nothing much will be accomplished in raising engineering earnings until more than a majority take their memberships in national professional societies seriously. We must get beyond the idea that the American Society of Civil Engineers is mainly a medium for exchanging and spreading technical information. Appreciating the value of membership in it and not doing anything is merely basking in the glory of those few who have done something to make the Society worth while. Are we not sailing under false colors if we wear the symbol of the greatest engineering society in the world, claim its honors and privileges, and yet do nothing at all ourselves? There are members who cannot be dragged into a Local Section meeting. There are members who feel that they are doing their part by attending meetings but who always refuse to do anything more. There are some who come for selfish reasons or merely to trade the latest gossip. The oldest members as a rule are willing to do their share and are anxious to maintain the reputation of the Society and keep alive all its activities There are others who would do more if their employers would permit them. So the first and most important requirement for making any Society program effective is a lot of active interest on the part of those who expect to be affected. Society members who are employers should encourage their personnel to participate in the Society's activities.

Some engineering salaries are set up by legal authorities. In most cases the governing bodies have the right to make any changes they may deem necessary and are usually affected by political activity on the part of those who hope to fill the positions. In governmental regulation the justness of compensation frequently is not a consideration. The control of engineering salaries by civil service bodies would not offer a satisfactory solution in Oklahoma unless these bodies were freed from political control. If political control must be tolerated, then the only way to effect engineering salary regulations is to induce engineers who are concerned with the problem to try to become members of the political bodies having the power. There are ways of counteracting civil service salary adjustments, and such actions should be decried publicly. Even now the taxing of salaries of politically-set-up payrolls has been reinstated. This will effect a further reduction in a remuneration already too low when compared with returns for the same service by non-political bodies.

Perhaps engineers enjoy their liberty so much that what we may mistake for lethargy is merely antipathy towards governmental or other control. There is a lot of objection to government interference. The spirit of independence is still so far from dead that many dislike to have government do for them what they cannot do for themselves. Yet we invited political aid in obtaining the engineer registration laws, and in my opinion political assistance is worth having.

Engineers employed politically or by corporations seldom compete with engineers working for themselves or for consultants. Their salaries are more or less fixed, and they are expected to devote all their engineering energy to their jobs. In corporations, those who employ engineers will have to be made familiar with the salary schedule and will have to be educated into realizing its desirability before we can secure their cooperation in making it effective.

Consulting practice is becoming harder to maintain because corporations and political bodies are coming more and more to hire engineers on salaries. Consulting engineers have said that private practice may ultimately disappear entirely and that at present it is more competitive than ever. They will be most difficult to win over to the Society's salary schedule. They employ engineers at minimum salaries and the employment is seasonal.

This entire problem in its many aspects is not a simple one. Promulgation of the present salary schedule is a good beginning, but the widest interest and most intensive efforts of individual members are essential if the schedule is to be effectively maintained.

Handbook of the City Planning Division Available

RECENTLY issued and now generally available is the City Planning Division Handbook. Its expressed purpose "is to make available a concise, usable record of the activities and accomplishments of the Division in its fifteen years of existence." This period, since 1923, coincides with many important developments in a new field of engineering. Hence this handbook, which records the various accomplishments of the Division in that interval, comprises in effect a summary of many of the more important advances.

Particularly is this true of the complete listing of Division programs from the very beginning. This is accompanied by a subject index as well as an author index of the papers delivered. The remainder of the 88-page booklet covers descriptions of committee work, record of officers, and a list of members.

Primarily this handbook was intended for the Division itself and accordingly was issued by the Division and distributed gratis to all its members. Although the Division could not justify its free distribution to all others it has made additional copies available at nominal prices on application to Headquarters. This attractive publication in cardboard covers may be secured at a cost of 25 cents to members and 50 cents to others.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies in 40 States

CONSTRUCTION CENSUS PLAN FOR 1940

UNDER the proposed plans for the 1940 Distribution Census, the Bureau of the Census of the U. S. Department of Commerce has developed schedules for ten subdivisions. The one of particular interest to engineering is the Construction Census. In cooperation with representatives of the construction industry, a schedule form for canvassing of general contractors, speculative builders, and special trade contractors has been worked out.

The Census Bureau has found it impracticable to include force account work in the 1940 Census not only because it would take a very large sum of money, perhaps an extra million dollars, but also because of the difficulties incident to canvassing individuals, organizations, and governmental units doing such work. The Bureau believes there will be approximately 100,000 to 125,000 reports in the present schedule. This Construction Census is a part of the Sixteenth Decennial Census of the United States which requires the Director of the Census to take a Census of Distribution of business transactions during the calendar year 1939.

The first Distribution Census was taken in 1929, as a result of recommendations made to Secretary of Commerce Hoover by a special advisory committee, of which Owen D. Young was chairman and F. M. Feiker, vice-chairman. The enormous detail incident to developing census procedures has been sympathetically reviewed by many advisory committees and each census represents an advance both in the character of the information gathered and in the facility of securing returns. An appropriation to cover this work is carried in the Commerce Department Appropriation bill, which has been passed by the House and reported to the Senate.

CONGRESS APPROVES STORAGE OF STRATEGIC MINERALS

Expenditure of $100,000,000, over a four-year period, for the purchase and storage of strategic minerals as a war reserve has been authorized by Congress. The bill, which received final approval by the Senate on June 5, does not designate the minerals to be affected but leaves their determination to the discretion of the Secretaries of War, the Navy, and the Interior. It also earmarks $2,000,000 of the total to be allocated to the development of domestic sources of supply of the minerals named or of domestic substitutes for them.

The bill was introduced as a national defense measure on the plea that the national safety requires the accumulation, in this country, of tin, manganese, and a number of other imported minerals essential in the manufacture of munitions that might be shut off in case of war.

REORGANIZATION EFFECTIVE JULY 1

The two plans for the reorganization of the executive departments of the federal government, including the setting up of a new Federal Works Agency in which will be concentrated virtually all present public works activities of the government, will both become effective July 1, 1939, according to a resolution approved by Congress.

Under the terms of the Reorganization Act each of the plans would have gone into effect 60 days after its submission to Congress, on June 19 and July 7, respectively. After each plan had been sustained by a vote, it was decided, in the interests of orderly administration, to adopt a single date for the changeover that coincides with the beginning of the federal government's fiscal year.

CONGRESS STUDIES METHODS OF AIDING BUSINESS EXPANSION

Government efforts to stimulate economic recovery are currently concentrated on ways and means of encouraging the spending of private capital in the so-called heavy industries, in which construction plays a prominent part. A number of plans are under consideration, of which the farthest advanced is embodied in a bill (S.2343) introduced by Senator Mead of New York, providing for the federal guarantee, through the Reconstruction Finance Corporation, of 90 per cent of the principal of loans made to private industry in amounts ranging from $25,000 to $1,000,000.

The crux of the problem seems to be the provision of long term capital credit for small and medium-sized business concerns. The situation is analyzed in a memorandum presented to the Temporary National Economic Committee by Adolf A. Berle, Jr., Assistant Secretary of State, which deserves careful study by any person interested. Briefly, Mr. Berle finds that, for a number of reasons, the capital markets have been virtually closed since 1931, thus forcing the government to take up the slack by greatly expanding public works. The result has been the expansion of governmental activity into many new fields, a trend that must continue unless some means can be found to restore the volume of private spending. To encourage this he proposes a system of capital credit banks which will "create" long-term credit in a manner similar to that used by commercial banks to expand and contract short-term credit facilities.

Behind the present interest in heavy industry is the unpalatable fact that construction has never recovered to any considerable extent from the slump into which it dropped in the early 1930's. From a peak annual volume of, in round numbers, 12 billion dollars, the value of all U. S. construction dropped to lows, for three successive years, of about three billions, and has since recovered only about half of the lost ground. Meanwhile the proportion of public to private expenditure has jumped from a pre-depression one-third to approximately two-thirds of the total volume for each year.

Public works construction, comprising roads, parks, bridges, buildings, and other facilities, produces but a temporary stimulus to employment, since once the project is completed little labor is required in operation. Private construction, on the other hand, goes largely for new plants and equipment that provide permanent jobs. Hence the current feeling that it might profit the government more to lose a few billions in the assumption of the bad risks in a much larger volume of private loans than to spend the same amount on a continuation of public works construction over and above the normal construction budget.

Nor does it necessarily follow that the government will be called upon to assume heavy losses. Much depends, of course, on the methods followed in selecting private loans for insurance, but the record of the past few years on federal lending has not been discouraging. A recent survey by the *United States News* discloses that since their establishment the Reconstruction Finance Corporation, Home Owners Loan Corporation, Export-Import Bank, and seven other federal lending organizations have advanced to business organizations, railroads, and governmental subdivisions a total of $10,928,128,626. Of this amount $5,771,615,388 has been repaid, and $5,156,513,238 is still outstanding. Interest and other income received has totaled $1,365,466,719 while interest charges paid out have amounted to only $637,379,724, leaving a net profit of $414,[illegible],729 after the deduction of $728,086,995 in operating expenses of the agencies. The figures should be accepted with caution because of the many variations in accounting methods used by the ten agencies but the general conclusion can hardly be challenged that the government has found it profitable to borrow at exceedingly low interest rates and lend at a somewhat higher figure.

Washington, D.C.
June 9, 1939

New England Student Chapter Conference Held

The second annual conference of New England Student Chapters was held at the University of New Hampshire Friday, May 12, 1939, jointly with the meeting of the Northeastern Local Section. There were present representatives from Brown University, Harvard University, University of Maine, Massachusetts Institute of Technology, University of New Hampshire, Norwich University, Rhode Island State College, Tufts College, and Worcester Polytechnic Institute. In addition Northeastern University, which has a student chapter of the Boston Society of Civil Engineers, was represented by several students.

The conference opened at 2 p.m. with an address by President Fred Engelhardt, of the University of New Hampshire, who stressed expanding employment possibilities for those civil engineers who are trained broadly to cooperate with planning and development agencies. Following this address, Dean George W. Case discussed various phases of the civil engineering curriculum.

Interesting papers were presented by the following students: "Polarized Light," including a demonstration of use in analyzing stresses in frames, by Joseph P. Zeitlen, Massachusetts Institute of Technology; "Architecture for the Engineer," by B. A. Coleman, Worcester Polytechnic Institute; and "The Future of Engineering," by Andrew P. Rebori, Massachusetts Institute of Technology. The student papers were very well prepared and ably presented. The afternoon meeting closed with a business session, after which the visitors were taken on an inspection tour of the campus.

In the evening a banquet held jointly with the Northeastern Section featured an address by J. K. Finch, former Director of the Society and Renwick Professor of Civil Engineering at Columbia University. Professor Finch spoke on "The Relationship of the Practicing Engineer to Engineering Education," emphasizing the fact that engineering schooling is only a small part of the education of the engineer, the greater part of his training being obtained only through apprenticeship and study after graduation. Professor Finch also endorsed President Engelhardt's contention that broad education is necessary for the engineer if he is to acquire the capacity to solve modern problems.

The sessions were planned and conducted by George C. Abbott, president of the Student Chapter at the University of New Hampshire, who furnished the data for this report.

News of Local Sections

Scheduled Meetings

Georgia Section—Inspection trip on July 10; meet at the Atlanta Athletic Club, at 4:30 p.m.

Indiana Section—Annual outing at Ross Camp, Purdue University, on July 16.

Oklahoma Section—Inspection and dinner meeting at Salt Plains Dam Site on July 15 in the afternoon and evening.

Sacramento Section—Regular luncheon meetings at the Elks Club every Tuesday, at 12:10 p.m.

San Francisco Section—Dinner meeting of the Junior Forum at the Aquatic Park Casino on July 24, at 6 p.m.

South Carolina Section—Summer meeting at Greenville, S.C., on July 14 and 15.

Recent Activities

Arizona Section—*Tucson, April 28* and *May 13:* The first of these meetings was a joint session with the Second Annual Roads and Streets Conference. The Hon. R. T. Jones, governor of Arizona, spoke at the opening session. A number of members of the Section addressed the four technical sessions that followed. The list of these included J. S. Mills, F. N. Grant, J. R. Van Horn, F. M. Guirey, W. R. Hutchins, and D. J. Lyons, all of the Arizona State Highway Department; George T. Grove, county engineer for Pima County; A. F. Rath, manager of the State-Wide Highway Planning Survey; and E. S. Borgquist, professor of civil engineering at the University of Arizona. John C. Park, president of the Arizona Section, presided at the dinner held in the evening. The annual spring meeting of the Section took place on May 13. Following a business meeting and luncheon with the Tucson Engineers Club, there was an interesting technical session. Those scheduled for this program were C. A. Firth, Federal Court Water Commissioner for the Gila River; G. L. McLane, senior highway engineer for the U. S. Bureau of Public Roads; Robert H. Rupkey, engineer for the U. S. Bureau of Reclamation; and George W. Marx, District State Sanitary Engineer for Southern Arizona. Russell Bates, president of the University of Arizona Student Chapter, presided at the joint dinner held with the Student Chapter that evening. The speakers were George T. Grove and two Student Chapter members—Otto J. Bejeck and Willett Van Loo. The Section's annual award of Junior membership in the Society went to Mr. Van Loo.

Central Illinois Section—*Champaign, April 24:* Following a dinner Donald H. Sawyer, President of the Society, gave an address on the subject, "The Engineer's Part in Recovery." In his talk President Sawyer outlined his theories of the engineer's human responsibilities in solving the economic and social problems of the day. *Urbana, May 18:* At this session three graduating seniors at the University of Illinois—Ira T. Chapman, Edward S. Fraser, and Howard Phillips—were awarded the Section's annual prize of Junior membership in the Society. The speaker of the evening was Charles E. De Leuw, consulting engineer on the Chicago subway. Mr. De Leuw's illustrated talk on the subject of Chicago's local transportation problem was followed by an enthusiastic discussion.

Colorado Section—*April 10* and *May 8:* The program scheduled for April 10 was sponsored by the Junior Association, and F. C. Hart, Junior representative to the president, was in the chair. The principal speakers were Dr. C. F. Kemper, president of the Denver County Medical Society, and James Wood, secretary of the Denver Bar Association. Both discussed the problems and activities of their respective organizations. On May 8 there was a joint session with the engineering students from the University of Colorado and Colorado State College. Students read papers on various engineering subjects, and several awards were made. The main topic of discussion was the work of the U. S. Forestry Department, and the opportunity to increase the national income by developing marginal forest land. This was presented by Allen S. Peck, regional forester for the U. S. Forest Service.

Dayton Section—*May 22:* The Section was host to the Student Chapters at the University of Dayton and Antioch College. Following luncheon the group was conducted on an inspection trip through the recently improved Dayton sewage treatment plant.

District of Columbia—*May 17:* This occasion was devoted to the Student Chapters in the area and to the Junior Forum. Prizes of Junior membership in the Society went to Clement H. McCormack, of Catholic University of America, and Allen N. Hallberg, of George Washington University. Then P. V. Douglas reported on the Maryland–District of Columbia Student Chapter Conference, and B. E. Jones gave a résumé of the Chattanooga Meeting. A talk on the necessity of evolving an equitable salary scale that will be representative of both employer and employee was given by John C. Hoyt. Motion pictures of Boulder Dam concluded the program.

Georgia Section—*Atlanta, May 8:* Members of the Georgia School of Technology Student Chapter had charge of the luncheon and furnished the entire program for this meeting. Gerald Johnson, retiring president of the Chapter, gave a résumé of student activities. Other members of the Chapter who spoke were Lucian

Harris and Norman Walton. To show its appreciation of the efforts of the Student Chapter, the Section voted to make a gift of a radio for the Student Chapter room at the Georgia School of Technology. In addition to the student talks, Hal H. Hale made a report on the Spring Meeting of the Society. Mr. Hale was the Section's official delegate.

Indiana Section—*Indianapolis, April 28:* The technical program at this dinner meeting consisted of a talk by Dr. Henry B. Hass, head of the school of chemistry at Purdue University, on the subject, "Explosives—Chemical Engineering of Interest to Civil Engineers." In his lecture Dr. Hass traced the history of explosives from the early days of Chinese civilization down to the present, including recent discoveries made by himself and his associates in the development of dynamite from natural gas, air, and steam. *West Lafayette, May 18:* Annual joint meeting with the Purdue University Student Chapter. Following a dinner, W. W. De Berard, Director of the Society and associate editor of *Engineering News-Record,* addressed the group on "The Engineer of Today." In his talk Mr. De Berard discussed professional objectives and environment and the part that technical societies play in solving the welfare problems of their members. John D. Goshorn and Frederick C. Ahrens, winners of the Section awards to outstanding engineering graduates, were presented with the certificates of award.

Iowa Section—*Iowa City, May 15:* Joint dinner meeting with the Engineers Club of Iowa City, the State University of Iowa Student Chapter, and the student branch of the American Society of Mechanical Engineers at the university. The feature of this gathering was an illustrated lecture on the Passamaquoddy Power Project, given by Lt. Col. P. B. Fleming.

Ithaca Section—*Ithaca, April 20:* E. W. Schoder, professor of experimental hydraulics at Cornell University, was the speaker at this session, his subject being "Studies on Energy Dissipation Below Dams." The studies were made at the Cornell Hydraulic Laboratory for a hydroelectric project in Virginia. A dinner preceded the meeting. *Binghamton, N.Y., May 9:* Joint meeting of the Section and the Broome Area Chapter of the New York State Society of Professional Engineers. An illustrated lecture on the "New England Hurricane and Its Effect on the Railroads" was given by Charles E. Smith, vice-president of the New York, New Haven and Hartford Railroad. A lengthy discussion of present-day conditions affecting the railroads followed the lecture.

Kentucky Section—*Lexington, May 19:* Joint meeting with the Student Chapters at the University of Kentucky and the University of Louisville. Student Chapter members were in charge of the program, which consisted of the presentation of a number of student papers. Prizes for the best papers went to Norman Wides and William H. Schulz. Those receiving the Section's award of Junior membership in the Society were William B. Auping, of the University of Kentucky, and J. R. Kingston, of the University of Louisville. The basis of selection was outstanding scholarship. A talk on the advantages of membership in the Society by J. E. Root, Director of the Society, concluded the program.

Los Angeles Section—*Pasadena, May 10:* This was the meeting that is held annually at the California Institute of Technology. Preceding the dinner and program, there was a tour of the campus, with Student Chapter members acting as guides. Among the interesting things to be seen was the grinding of the 200-in. Palomar lens at the Palomar Observatory. The technical program, which was in charge of the Student Chapter at the institute, proved of interest to all. The principal speaker was Dr. Robert A. Millikan, who described the development and present activities of the California Institute of Technology, tracing its history from 1908, when it was only a secondary school specializing in manual training, to its present rank as one of our foremost technical institutions. Reports were then given by advanced graduate students—James W. Daily, Vito A. Vanoni, and Warren O. Wagner—on their Ph.D. research projects. All the talks were well illustrated with slides.

Louisiana Section—*New Orleans, April 24:* The feature of this regular meeting was an illustrated talk on "Building Methods near the Arctic Circle." This was given by Andrew Sandegren, construction engineer of the Procurement Division of the U. S. Treasury Department, who was in charge of government construction at Nome, Alaska. Prior to this talk E. S. Bres, Director of the Society, presented a key to Joseph R. Mooney, of Tulane University, for his paper on "The Use of Asphalt Mattress on Mississippi River Bank Construction," which was presented at the Spring Meeting. It has been announced that the Section's awards of Junior membership in the Society go to Charles E. Beadles, of Louisiana State University, and D. E. Guiza, of Tulane.

Maryland Section—*Baltimore, May 16* and *May 25:* The award of the Section's prizes of membership in the Society initiated the meeting on the 16th. Those thus honored were Samuel H Spragens, of Johns Hopkins University, and Thomas P. Wharton, of the University of Maryland. The meeting was then turned over to the students, Mr. Spragens and E. B. Robertson acting as co-chairmen. The broad subject of discussion was "The Engineer in Public Works," and the following participated in this symposium: Edward Wenk, Charles C. Holbrook, John F. O'Rourke, and William B. Davis. Brief talks by Edward J. Dougherty, president of the Section, and Wilson T. Ballard, Contact Member for the Johns Hopkins University Student Chapter, concluded the evening. On the 25th Col. Paul Weeks spoke on "Modern Methods of Construction," illustrating his talk with motion pictures. Informal discussion followed his remarks. *Junior Association, May 9:* At this organization meeting the provisions of the constitution were discussed, and officers elected. These are F. B. Hall, president; A. F. Sack, vice-president; and F. J. Vassalotti, secretary.

Metropolitan Section—*New York City, May 17:* "Schooling and the Education of Civil Engineers" was the topic of Hardy Cross' address presented at this session. Professor Cross, who is professor of civil engineering at Yale University, discussed the possibility of correlating the humanities and sciences in civil engineering. A special feature of the occasion was the Annual Effective Speaking Contest, conducted by the Junior Branch. The first prize of $15 went to P. R. Grossman for his address on "The Foreign Policy of the United States," and second prize of $10 to Franklin C. Rogers, who discussed "National Spending." Honorable-mention prizes in the form of books were presented to Arthur Dalphond and Sherman Glass. The next item on the program was the award of the Robert Ridgway Student Chapter Prize to the outstanding student in each of the eight Student Chapters of the Metropolitan district. These prizes, consisting of the payment of the entrance fee to the Society, the remission of the first year's dues in the Society and the Section, and the badge of a Junior, went to Roscoe Guernsey, Jr., Columbia University; James M. Allaire, Cooper Union; John J. Wagner, Manhattan College; George A. Valente, Newark College of Engineering; Kenneth G. Barnhill, New York University; Harold A. Wilde, College of the City of New York; Charles O. Klimas, Polytechnic Institute of Brooklyn; and Paul B. Greetin, Rutgers University. During the annual business meeting George W. Burpee was elected president; C. W. Bryan, Jr., second vice-president; and Charles E. Trout, treasurer. Col. William J. Shea will continue as secretary.

Mohawk-Hudson Section—*Troy, N.Y., June 6:* Preceding the meeting, there was a dinner in the Students Club House at Rensselaer Polytechnic Institute. The technical program consisted of four papers presented in a competition for Juniors by the following: Clyde P. Parkinson, junior hydraulic engineer for the U. S. Geological Survey; Frederick A. Smith, time study engineer for the Albany Felt Company; Clarence W. Davies, structural draftsman for the General Electric Company; and G. Reed Shaw, associate professor of geodesy and transportation engineering at Rensselaer Polytechnic Institute. Professor Shaw got first prize for his paper on the New York State system of plane coordinates.

Nashville Section—*June 6:* W. A. Coolidge, associate professor of civil engineering at Vanderbilt University, discussed the activities of the Society in regard to professional objectives and read the Society's latest recommendations for the guidance of Local Sections. A round-table discussion revealed the fact that the encouragement of Juniors is one of the most pressing needs of the Nashville Section.

Nebraska Section—*Lincoln, April 1:* Held in conjunction with the annual meeting of the Nebraska Engineers Society. An illuminating talk on the activities and interests of the Society was given by W. W. De Berard, Director of the Society and associate editor of *Engineering News-Record.* A special feature of the occasion was the fact that there were special luncheon meetings at noon for the members of the Section as well as for members of local groups of the other engineering societies participating.

New Mexico Section—*Albuquerque, April 20:* A number of members of the University of New Mexico Student Chapter were guests of the Section on this occasion. The speaker was Harold B. Elmendorf, of the Bureau of Agricultural Economics, who gave a talk on the Water Facilities Act.

Northwestern Section—*Minneapolis, May 1* and *June 9:* Joint meeting with the University of Minnesota Student Chapter. H. M. Hill, chairman of the Committee on Junior and Student Affairs, announced that the following were winners of the Section's annual awards of membership in the Society: Kenneth Sorenson, Charles T. Hook, and Leslie Anderson, of the University of Minnesota; Lorys J. Larson, of South Dakota State College; and Montelle N. Boone and Francis W. Maxwell, of the University of North Dakota. L. E. Ayres, Director of the Society, spoke on "A Director Calls for Help," in which he discussed some of the problems of Society officials. Vice-President James L. Ferebee then gave some of his opinions regarding the possible future effect of the state licensing boards on the engineering profession. The principal address of the evening was given by President Sawyer, who discussed the subject, "Why Affiliate with the Society?" At the meeting on June 9 A. L. Johnson, Minneapolis contractor, gave an illustrated talk on some of the construction problems in connection with Contract #112 of the Minneapolis–St. Paul Sanitary District. He was followed by George Schroepfer, chief engineer of the Sanitary District, who discussed the location and cost studies of the entire improvement.

Oregon Section—*Portland, May 16:* A talk on the activities of the Student Chapter at Oregon State College was given by C. A. Mockmore, professor and head of the department of civil engineering. It was then announced that John Allen and Kenneth Lange, members of the Student Chapter, were the winners of the Section's annual awards of Junior membership in the Society, the basis of selection being the best papers submitted in competition. Honorable mention went to David Lewis and Elwood Lawrence. The four students then read their winning papers.

Philadelphia Section—*May 17:* Unusual types of steel structures were discussed at this session. Charles F. Frantz, chief estimator in charge of engineering and estimating for the Lehigh Structural Steel Company, discussed a new type of hangar recently built in Baltimore, where by placing four columns at predetermined points in the hangar and using cantilever construction, it was found possible to accommodate two and a half times the number of planes that can be stored in a hangar of the usual type. A paper on "Structural Phases of the Lighting System at Shibe Park" by Joseph G. Shryock, chief engineer of the Belmont Iron Works, Philadelphia, was read by another member of the same company in Mr. Shryock's absence. A discussion from the floor concluded the meeting.

Pittsburgh Section—*May 4:* At this gathering Lewis W. McIntyre was elected president for the coming year, and Louis P. Blum, vice-president. Charles B. Stanton will continue as secretary-treasurer.

Providence Section: The Providence Section reports that its new officers are as follows: Frank W. Stubbs, Jr., chairman; Henry A. Whitcomb, vice-chairman; and Frederick H. Paulson, secretary-treasurer.

Sacramento Section—*May 2, 9, 16,* and *23:* At the first of these regular luncheon meetings a four-reel motion picture, showing modern methods of construction of a recently completed California highway project, were shown. On the 9th Maj. Oliver J. Todd, who has served as chief engineer of the China-International Famine Commission and as consulting engineer to the Chinese government, gave an illustrated talk on his engineering experiences in China. The speakers at the other two luncheons were C. H. Benedict, who presented a paper on asphalt revetments, and T. E. Stanton, Jr., Director of the Society, who reviewed the Chattanooga Meeting. *Junior Forum, May 10:* The speakers at this gathering were R. L. Richardson, who discussed "Foundation Investigations as Related to Highways," and William Popper, whose subject was "The Unique Construction of the Oakland–Alameda Tube." Both are members of the Junior Forum.

St. Louis Section—*Clarksville, Mo., May 27:* The regular monthly meeting of the Section for May was replaced by an inspection trip to Lock and Dam No. 24 of the Mississippi River Channel Project at Clarksville, Mo. This project, the last of the 26 locks and dams built to provide a 9-ft navigation channel from Alton, Ill., to St. Paul, Minn., is nearing completion and is in just the stage to provide the best display of both construction and operation features. The Mid-Missouri, Central Illinois, and Iowa Sections of the Society; the St. Louis and Iowa University Posts of the Society of American Military Engineers; and the Engineers Club of St. Louis were also invited to make the trip. Although no formal meeting was held, announcement was made of the Section's annual awards of membership in the Society to the two outstanding engineering graduates in the region. These are Charles I. Mansur, of the University of Missouri, and William T. Flynn, Jr., of Washington University.

San Diego Section—*March 23, April 11,* and *May 25:* At the meeting on March 23 the speaker was Wilbert Lee, who discussed the subject of water law. The meeting on April 11 took the form of a joint session with the San Diego Engineers Club. A talk on triangulation work was the feature of the occasion. This was given by Frank Johnson, of the U. S. Coast and Geodetic Survey. On May 25 members of the Section were privileged to make an inspection trip aboard the *U. S. S. Stingray,* a submarine based in San Diego Bay. Lt. Commander L. N. Blair, commanding officer of the submarine, was the host, and gave the members an interesting insight into the workings of underseas craft. The regular monthly meeting was held that evening, with Commander William M. Quigley as speaker. Of special interest was the model of the rescue bell used for bringing the *Squalus* survivors to the surface.

Seattle Section—*May 22:* An illustrated lecture on the Isaac Stevens Dam was given by Col. Herbert J. Wild, district engineer for the U. S. Engineer Office at Seattle. This dam is to be constructed near Enumclaw, Wash., as a flood-control measure for the White and Puyallup rivers. Colonel Wild explained that peculiar subsurface conditions require that the dam be a rolled earth-fill structure. The dam will be 400 ft high, which will make it the highest of its type ever to be built.

Spokane Section—*May 12* and *20:* The luncheon meeting on May 12 was devoted to business discussion. On the 20th there was a special meeting at Grand Coulee Dam. During the afternoon the members and their student guests were conducted over the project by engineers with the U. S. Bureau of Reclamation. Following a dinner in the evening, Grant Gordon, of the U. S. Bureau of Reclamation, gave an interesting talk on the geology of the area. A discussion period concluded the program.

Syracuse Section—*May 24:* The annual election of officers held at this time resulted as follows: H. N. Cole, president; J. H. Sturdevant, first vice-president; J. W. Ackerman, second vice-president; C. S. Camp, secretary-treasurer. F. D. McKeon will continue as acting secretary-treasurer. The technical program consisted of a talk on "Managed Currency," given by Dr. Charles L. Prather, of Syracuse University.

Tacoma Section—*May 9:* Several speakers were heard at this gathering. These were B. P. Thomas, chief engineer of the Inter-County River Improvement Commission; Capt. Arthur G. Trudeau, of the Corps of Engineers; and Col. H. J. Wild, district engineer for the U. S. Engineer Office at Seattle. All discussed various aspects of the Mud Mountain Dam project.

Toledo Section—*May 25:* Following a dinner at the Sylvania Country Club, there was a talk on oil refining. This was given by Harry Gillett, Jr., manager of the sales engineering department for the Standard Oil Company of Ohio. Mr. Gillett described the results obtained in his company's field research laboratories, supplementing his remarks by actual demonstrations on an Ethyl Knock Machine and Flame Tube.

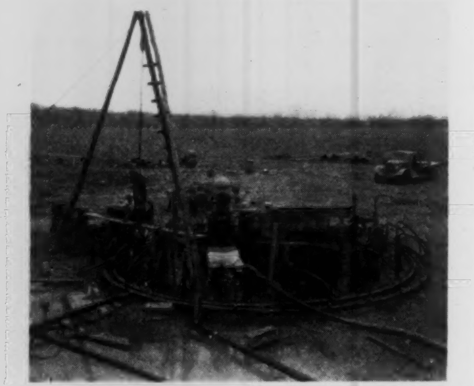
Wisconsin Section—*Madison, May 2:* Joint dinner meeting with the Technical Club of Madison. The guest of honor and principal speaker on this occasion was Donald H. Sawyer, President of the Society, who discussed the aims, activities, and accomplishments of the Society. *Milwaukee, June 2:* A great deal of business was transacted at this session, and announcement was made of the Section's annual awards of Junior membership in the Society. These go to Paul Scheid and Phil Cunningham, of the Marquette University Student Chapter; and to J. C. Dietz, Jr., of the University of Wisconsin. These three students read their papers, which were the basis on which the awards were made. Vice-President Ferebee then gave a report on the Chattanooga Society Meeting and discussed the problems confronting the Board.

ITEMS OF INTEREST

Engineering Events in Brief

Civil Engineering for August

When the first bucket of concrete was poured at Norris Dam five years ago, it was said that the dam was one-third completed. Such a statement forcefully illustrates the relative importance of the preliminary construction work necessary on large projects, and fittingly introduces the paper on "Principles of Construction Plant Planning for Large Dams," which R. T. Colburn contributes for the August issue of Civil Engineering. His examples are drawn from experiences of the Tennessee Valley Authority, whose series of dam-building projects has provided a unique opportunity for systematic and economical construction plant planning.



Test Shaft at Gilbertsville Dam, with Freezing Wells in Place.

Engineering aspects of the influence of forests on mountain streams are to be discussed by Richard A. Hertzler in an article describing current work of the Appalachian Forest Experiment Station. Land-use–runoff relationships, infiltration capacity of forest soils, and the use of the unit-graph principle in analyzing runoff from small drainage basins are among the topics covered. Another hydraulics article on the schedule is "Notes on the Hydraulic Jump," by Fred C. Scobey, originally announced for July.

A brief article by Edwin B. Eckel will describe abutment problems at Zuni Dam, where loose sand under permeable basalt twice caused partial failures. Recent repairs, involving a clay blanket, are expected to prove effective and permanent.

Otis E. Hovey contributes for the August issue some entertaining and thought-provoking personal reminiscences covering a long and distinguished professional career. George Altvater writes on "Subway Station Layouts," with a view to stimulating discussion on the possibility of standardization in future work. Ned Sayford describes the organization of TVA's surveying and mapping activities. And space may permit including one or two papers from the Annual Convention.

"The Greatest in the World"

The following paragraphs anent the Engineering Societies Library are abstracted from a recent address by A. R. Mumford, chairman of the board of that institution. Occasion for the address was a dinner in honor of William S. Barstow, a member of the American Institute of Electrical Engineers, who has been for several years a member of the Library Board and who has helped in numerous ways to promote its activities.

The speech appears in full in the July issue of "Mechanical Engineering."

It is said that a prophet is not without honor except in his own country. So with your library. The average member of the four Founder Societies takes the library for granted. The assistant state librarian of Canberra, Australia, however, told me the other day that he had come half way around this earth to see your library because of its fame as an outstanding example of a specialized institution.

What makes this greatness?

Is it the 160,000 volumes which, if placed side by side on a single shelf, would be as long as you could walk in one and one-half hours—briskly?

Is it the growth which has averaged two volumes every three library hours for the past twenty-five years and totaled 100,000 in that period?

Is it the 1,200 magazines which currently come to the library each year and came during even the worst years of the depression?

Is it the ten thousand dollars worth of books which comes free to the library each year in return for the reviews written by its director?

Is it the 11 incunabula, books published before Columbus discovered America, or the 100 volumes printed between his discovery and the visit of the *Mayflower*?

Is it the fact that more engineering books printed prior to the secession of Texas from Mexico are available in your library than in any other?

Or is it the alloying of all these with the farsightedness of such men as our guest of honor?

In these days of low money rates, how pleasing it is to know that your library has grown at the rate of 6 per cent compounded. This growth indicates a virility which must be pleasing to those who realized the need for such an institution.

An average of 150 persons or firms uses the facilities of your library each day. The information so gained helps to develop projects which undoubtedly give employment to many of our profession throughout the world.

When you look at the face of your watch it tells you the hour. You don't worry about the works. The library reading room is its watch face. You ask the question at this point and get the answer. Two floors of bookstacks back up the reading room and are made available to you by a corps of experts. A search, a translation, a photostatic copy, or a bibliography, all are readily available. On minor matters no charge is made to members. On the larger matters service is available at cost.

The organization set up to administer your library consists of a board representing the Founder Societies and the United Engineering Trustees, Inc. It meets three times each year. Its executive committee, consisting of four board members and the chairman, meets each month. The library is under the immediate control of its director, Dr. Harrison W. Craver. Reporting to him are four departments—acquisition, cataloging, reference, and service. Dr. Craver has successfully merged the original libraries of the Founder Societies into a useful tool. His problem was as great and as involved as is the merging of companies. His success is attested by the world-wide appreciation of the standing of your library.

At each of our Board and Executive Committee meetings of the last three years, one subject has always been discussed: How can the Library be made of greater service to engineers? Just as regularly the answer has developed—when we have more money. Strangely enough the library cannot be operated without funds. About $50,000 is now spent each year. Some of that comes from a permanent endowment of $200,000, which ought to be two million, and the rest from appropriations from the membership dues of the Founder Societies.

We want to serve the remote member more fully. We want to publicize the availability of library services without fear that the demands will cause us to exceed our budget allotment. These goals have been our aim. What progress we have made has been with the advice and aid of such men as our guest of honor.

NEWS OF ENGINEERS

Personal Items About Society Members

Ezra B. Whitman, consulting engineer of Baltimore, Md., was recently appointed to the chairmanship of the Maryland State Highway Commission.

Paul R. Speer, formerly associate engineer for the U. S. Geological Survey at Albany, N.Y., has been appointed district engineer for the Survey at St. Paul, Minn., to fill the vacancy caused by the death of C. L. Batchelder.

Albert Haertlein, associate professor of civil engineering at the Harvard Graduate School of Engineering, Harvard University, has been elected secretary of the Engineering Societies of New England for the year beginning June 1.

John [illegible] Long, former engineer of Duval County, Florida, has been appointed engineer-manager of the County Officials Division of the American Road Builders' Association, with headquarters in Washington, D.C.

Henry G. Groves is with the Yale Oil Corporation at Billings, Mont., in the capacity of bituminous engineer.

Roy B. Williams, construction engineer for the U. S. Bureau of Reclamation in Washington, D.C., has been designated construction engineer of the Friant division of the Central Valley Project at Fresno, Calif., where construction of Friant Dam will soon start.

Harry W. Bashore, who has been serving as construction engineer for the Bureau of Reclamation on the nearly completed Kendrick Project at Casper, Wyo., will take over Mr. Williams' duties in Washington.

George Lamb has been promoted from the position of assistant office bridge engineer for the Kansas State Highway Commission to that of office bridge engineer.

W. D. Merritt has resigned his post as city engineer of Mt. Airy, N.C., in order to do graduate work at the University of North Carolina.

John G. Turney, chief engineer for the Railroad Commission of Texas, has been appointed first assistant city engineer of Houston, Tex.

T. Roesch has left the engineering staff of the Indiana State Highway Commission to join the engineering department of Montgomery-Ward in the capacity of structural engineer and designer. His headquarters are in Chicago, Ill.

Chad F. Calhoun has established the Reliance Steel Products Company at 2068 East 37th Street, Los Angeles, Calif. The company will specialize in the fabrication and merchandising of reinforcing steel and allied steel products.

Huber E. Smutz will succeed W. N. Thorpe as acting city planning director of Los Angeles, Calif. Until recently Mr. Smutz was zoning engineer in the Los Angeles city planning department.

Albert V. Sielke, previously consulting engineer for the New York City Department of Parks, has opened consulting offices in New York.

T. M. Lowe has resigned as associate professor of civil engineering at the University of Florida in order to become head of the civil engineering department at Alabama Polytechnic Institute.

W. L. Sawyer succeeds T. M. Lowe as associate professor of civil engineering at the University of Florida. He was formerly assistant professor.

Ralph Whitman, captain, C.E.C., U. S. Navy, has been advanced to the rank of rear admiral to fill the vacancy caused by the death of Ralph M. Warfield.

John D. Quinn, former state engineer of Wyoming, has been appointed resident engineer-inspector on a PWA sewer and sanitation project at Sheridan, Wyo.

C. C. Hallvik is now materials engineer in the Idaho State Bureau of Highways. He has been connected with the department for the past nine years.

Alexander Haring, retired professor of bridge and railroad engineering at New York University, has been appointed secretary to the New York City Department of Public Works.

John D. Whittaker, until recently assistant resident engineer for the British Columbia Pulp and Paper Company, Ltd., at Woodfibre, B.C., has accepted a position as sales engineer for Gutta Percha and Rubber, Ltd., with headquarters at Vancouver, B.C.

A. George Sunda has resigned as instructor in the department of civil engineering at the University of Tennessee and is now employed as engineering aide with the Federal Power Commission in Washington, D.C.

Harley B. Ferguson, brigadier general, Corps of Engineers, U. S. Army, will retire as president of the Mississippi River Commission on August 15, when he will reach the retirement age.

Max C. Tyler, brigadier general, Corps of Engineers, will succeed General Ferguson as president of the Mississippi River Commission. Since July 1936 General Tyler has been serving as assistant to the Chief of Engineers, U. S. War Department, with headquarters in Washington, D.C.

Hunter Rouse has been appointed professor of hydraulics at the college of engineering of the University of Iowa. He will also be consulting engineer to the Iowa Institute of Hydraulic Research. Professor Rouse has been associate hydraulic engineer for the Soil Conservation Service and assistant professor of fluid mechanics at the California Institute of Technology.

Henry H. Garrigues, formerly general superintendent of the Central Pennsylvania Division of the Pennsylvania Railroad, has been promoted to the position of chief engineer, maintenance of way, in the eastern region.

J. E. Crawford was recently promoted from the rank of vice-president in charge of operation of the Norfolk and Western Railway to that of vice-president-assistant to the president. Mr. Crawford has been on the staff of this railway since 1903.

Karl A. Sinclair, for the past three years with the PWA at Honolulu, Hawaii, has been appointed PWA administrator for the territory.

R. Stanley Lord, assistant hydraulic engineer for the Water Resources Branch of the U. S. Geological Survey, has been transferred from Los Angeles, Calif., to the Washington headquarters of the Survey.

Edward L. Harrison, architect of Memphis, Tenn., has been appointed to represent the Memphis Housing Authority on construction of two new slum clearance projects for the city. He has the title chief clerk of work.

Earl R. Weeber, consulting engineer of Grand Rapids, Mich., has been elected president of the Michigan Engineering Society.

Marcus W. Levy is now architect and engineer for Alexander L. Levy, of Chicago, Ill.

John Stearns, formerly principal engineer in the Division of Power and Flood Control Service of the Federal Power Commission, has accepted an appointment as assistant executive director of the Los Angeles County Housing Authority, with headquarters in Los Angeles.

A. Perry Banta was recently appointed assistant professor of sanitary engineering at the California Institute of Technology. Mr. Banta will continue to hold his post as assistant engineer of the Los Angeles County Districts, but by special arrangement with the officials of the Districts he will be given time for his work at the Institute.

Charles L. Pool, chief engineer of the Rhode Island State Department of Public Health, has been appointed a member of the Rhode Island State Board of Registration for Professional Engineers and Land Surveyors for a five-year term.

Harold D. Cavin, formerly head of the firm of Cavin, Marshall and Barr, consulting engineers, with offices in Seattle, Wash., has accepted a position as resident engineer for the Hardy S. Ferguson Company, consulting engineers of New York, on the construction of a pulp and paper mill at Mobile, Ala.

James W. Follin is now managing director of the Producers' Guild Council, with headquarters in New York City. Until recently he was chief of the Federal Home Building Service Section of the Federal Home Loan Bank Board, Washington, D.C.

Charles Terzaghi has accepted a three-year appointment as lecturer on soil mechanics and engineering geology in the Harvard University Graduate School of Engineering. Dr. Terzaghi has previously been visiting lecturer at Harvard, but the present appointment gives him rank as a member of the faculty.

Howard M. Turner, consulting engineer of Boston, has also been appointed a lecturer in the Harvard University Graduate School of Engineering. His subject will be water power engineering.

Edwin J. Fort, who has just retired as project engineer in the New York City Department of Public Works, was honored by his colleagues at a testimonial luncheon held at the Hotel St. George in Brooklyn on May 23. On June 1 Mr. Fort completed thirty-three years in the service of the city. Following a short vacation, he plans to engage in consulting work in connection with sewage disposal.

Carnig Kay has accepted a position as senior inspector of construction in the

Bureau of Yards and Docks of the Navy Department and is stationed at the Brooklyn Navy Yard. He was previously general construction inspector for the Metropolitan District Water Supply Commission at Belchertown, Mass.

Walter R. Okeson, treasurer of Lehigh University since 1923, has been named to the additional post of vice-president. He will be in charge of the business affairs of the university.

Harry D. Winsor, assistant engineer for the Board of Transportation, New York, has been elected president of the Municipal Engineers of the City of New York. Other members of the Society—**Arthur W. Tidd**, **Patrick Quilty**, and **Alfred Brahdy**—have also been elected officers of this organization.

DECEASED

Algernon Brown Alderson (M. '12) of West Hartford, Conn., died there on May 13, 1939, at the age of 71. A native of England, Mr. Alderson's first work in this country was as town engineer of West Hartford—a position he held from 1898 to 1918. During this period he designed and built several systems of sanitary sewers and improved highways. From 1918 on he was in private practice and was also connected with the West Hartford engineering office and with the Connecticut State Highway Department. He retired several years ago.

Robert Edward Austin (Jun. '36) of Jacksonville, Fla., died on November 17, 1938, at the age of 24. Upon Mr. Austin's graduation from the University of Florida in 1936, he was awarded the Florida Section prize of Junior membership in the Society. For the two years preceding his death he was with Shore Line Builders, Inc., of Jacksonville.

Calvin Lewis Barton (M. '14) of Norwalk, Conn., died on May 10, 1939, at the age of 64. In 1906, after early experience in subway and tunnel construction work in New York, Mr. Barton became superintendent and manager of his own contracting firm, the McHarg-Barton Company, of New York. From 1928 to 1931 he was an engineer with the Fraser-Brace Company on the construction of dams at Fifteen Mile Falls and McIndoes, Vt. Later he was again in private practice and, for a time, was connected with the FERA.

Charles Emery Billin (M. '78) of Philadelphia, Pa., died on May 24, 1939. During his early career Mr. Billin was engaged in engineering work in New York and Chicago—for a time with the Quincy, Manchester, Sargent Company, of the latter city. Later he was for a number of years secretary of the Engineers Club of Philadelphia, which he had been instrumental in founding. Mr. Billin had one of the longest affiliations with the Society among its membership.

William Henry Dittoe (M. '19) secretary and chief engineer of the Mahoning Valley Sanitary District, Youngstown, Ohio, died there on May 26, 1939. He was 53. From 1908 to 1926 Mr. Dittoe was in the Ohio State Department of Health—first as assistant engineer and, later, as chief engineer. In 1926 he became connected with the Mahoning Valley Sanitary District.

Franklin Mechtley Felker (Jun. '31) assistant flood engineer in the Flood Control Bureau of the Pennsylvania State Department of Forests and Waters, died on May 29, 1939. Mr. Felker, who was 30, had been in the Pennsylvania Department of Forests and Waters since 1933. Prior to that he was a transitman with the Standard Steel Works Company, of Burnham, Pa.

Edward Francis Haas (M. '06) president of the Union Dredging Company, San Francisco, Calif., died on April 13, 1939, at the age of 69. Except for two years in Honolulu, Mr. Haas devoted his whole professional career to work in California, his native state. At one time he was assistant engineer for the late C. E. Grunsky, Past-President of the Society. Later, as a member of the firm, Ferris and Haas, he was engaged in extensive reclamation projects in Marin and Contra Costa counties. Coincident with his position as president of the Union Dredging Company, Mr. Haas maintained a consulting practice under the firm name, Haas, Doughty and Jones.

Milo Clinton Halsey (Assoc. M. '13) structural engineer for the Pacific Electric Railway, South Pasadena, Calif., died on May 12, 1939, at the age of 57. Mr. Halsey had been with the Pacific Electric Railway Company since 1910, when he became chief draftsman for the company. He was made structural engineer in 1911. Mr. Halsey was long active in the affairs of the Los Angeles Section and, at one time, served as treasurer.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

Harry J. Hanmer (Assoc. M. '12) city engineer of Gloversville, N.Y., died on May 4, 1939, at the age of 57. From 1907 to 1913 Mr. Hanmer was assistant city engineer of Gloversville in charge of the construction of a sewage disposal plant. He held the position of city engineer from 1913 on.

John Kylstra (Assoc. M. '27) chief engineer for the Boeing Aircraft Company, Seattle, Wash., died on March 18, 1939, at the age of 42. Mr. Kylstra was born in the Netherlands and educated in this country. In 1924, after two years with the Pacific Telephone and Telegraph Company, he became stress engineer for the Boeing Aircraft Company. Later he served as chief stress engineer and project engineer for this company, and about a year ago he was made chief engineer.

John Thomas Mockler (M. '30) acting city engineer of Buffalo (N.Y.) until his retirement about a year ago, died in that city on May 7, 1939. He was 51. Mr. Mockler had been in the Buffalo city service since 1917, with the exception of two years in war service as a lieutenant in the Corps of Engineers. Prior to 1917 he was in the New York State Highway Department and the New York State Engineer Department.

John Henry Quinton (M. '00) retired consulting engineer of Los Angeles, Calif., died there on May 9, 1939, at the age of 89. Born and educated in Ireland, Mr. Quinton went to California in 1873. In 1884 he entered private practice in Los Angeles. During his long career he was identified with many important water-supply and reclamation projects in the West, including the San Gabriel Canyon power development, the Santa Ana River irrigation system, the Strawberry Project (Utah), the Shoshone Project (Wyoming), and the Owens River Aqueduct of Los Angeles. Mr. Quinton retired from active business in 1926, but retained an interest in his firm (now Quinton, Code, Hill-Leeds and Barnard).

Harold Bemis Shattuck (M. '30) professor emeritus of railroad engineering at Pennsylvania State College, died on April 25, 1939, at the age of 65. Professor Shattuck spent practically his entire professional career—from 1901 until his retirement in 1936—at Pennsylvania State College. During most of this period he also maintained a civil engineering and surveying practice.

Ross Kerr Tiffany (M. '20) executive officer for the Washington State Planning Council, Olympia, Wash., died suddenly at Colville, Wash., on June 1, 1939. He would have been 60 on June 11. At the time of his death Mr. Tiffany was serving a term as Director of the Society from District 12. A brief account of his career appears in the "Society Affairs" department of this issue.

Wilbur Jay Watson (M. '05) architect and engineer of Cleveland, Ohio, died in that city on May 20, 1939, at the age of 68. From 1889 to 1894 Mr. Watson was in the engineering department of the Lake Shore and Michigan Southern Railway, and from 1898 to 1907 he was designer and supervisor of construction for the Osborn Engineering Company. In the latter year he became senior partner in the consulting firm, Wilbur Watson and Associates. Mr. Watson's firm was engaged in the construction of many bridge, factory, and terminal developments in Ohio, including the Goodyear Zeppelin Dock at Akron.

Frank Wilcox (M. '03) of Columbus, Ohio, died on May 25, 1939, on the eve of his eighty-fifth birthday. From 1892 to 1920 Mr. Wilcox was engineer and director of the T. A. Gillespie and East Jersey Pipe Company, with headquarters in New York and Pittsburgh. During this period he was engaged in building water works, reservoirs, and large steel pipe lines for water and gas conveyance in many parts of the country. He retired in 1920.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From May 10 to June 9, 1939, Inclusive

ADDITIONS TO MEMBERSHIP

Adland, Edwin Ralph (Assoc. M. '39), Asst. Engr., U. S. Engr. Office, Rock Island, Ill. (Res., 519 Conger St., Waterloo, Iowa.)

Akushka, Michael Peter (Jun. '38), 358 Bradford St., Brooklyn, N.Y.

Armstrong, Henry K. (Assoc. M. '39), Associate Engr. (Civ.), Board of Engrs., Rivers and Harbors, War Dept., 2 New York Ave., N.W., Washington, D.C.

Arnold, Oran Glen (Jun. '38), 601 Main Ave., Brownwood, Tex.

Beggs, John Joseph (Assoc. M. '39), Asst. to Engr. in chg., Topographical Bureau, Borough of Queens, City of New York (Res., 54–12 Thirty-Second Ave., Woodside), N.Y.

Bradshaw, Earl Lee (Assoc. M. '39), Engr. in chg., McClellan Creek Dam, Bureau of Agri. Economics, U. S. Dept. of Agriculture, McLean, Tex.

Brady, Emmett Edward (Jun. '38), Calaveras Ranger Station, Avery, Calif.

Cafaro, Martin (Jun. '39), 309 East 28th St., New York, N.Y.

Calkins, Harold Almon (M. '39), Chf. Engr., California Packing Corporation, 101 California, San Francisco, Calif.

Carr, James Kennedy (Jun. '39), Junior Engr., Field Section, U. S. Bureau of Reclamation (Res., 2005 Court St.), Redding, Calif.

Charles, Robert Simpson, Jr. (Assoc. M. '39), Field Engr., International Water Supply, Ltd. (Res., 181 Elmwood Ave.), London, Ont., Canada.

Christman, Francis Sherman (Jun. '38), 1163 Laurel Ave., Akron, Ohio.

Cleary, Edward John (Assoc. M. '39), Asst. Editor, Engineering News-Record, 330 West 42d St., New York, N.Y. (Res., Old Quarry Rd., Upper Montclair, N.J.)

Crockett, Argyle Campbell, Jr. (Jun. '38), Engr., Fulton County Public Works Dept., 501 Court House (Res., 33 Eleventh St., N.E.), Atlanta, Ga.

Daly, Edmund Shaftesbury (Jun. '39), Junior Hydr. Engr., TVA (Res., 1704 Melbourne Ave.), Knoxville, Tenn.

Derr, Orville Vosbury (M. '39), Valuation Engr., Valuation Dept., Erie R.R., 10 North Fulton Ave., Mount Vernon, N.Y.

Dunlop, Arthur Cecil (Assoc. M. '39), Associate Eng. Appraiser, Eng. Dept., Federal Land Bank of Berkeley (Res., 2810 Ashby Ave.), Berkeley, Calif.

Elkman, Sidney (Jun. '39), Field Insp., Colonial Beacon Oil Co., 32 Wethersfield Ave., Hartford, Conn.

Ellington, Harold Slaight (M. '39), Archt. and Engr., (Harley & Ellington), 1507 Stroh Bldg., Detroit, Mich.

Gale, James McNichol (Jun. '38), 207 South 13th St., Palatka, Fla.

Glenn, Howard Allen (Assoc. M. '39), Gen. Supt., Standard Bitulithic Co., 50 Church St., New York, N.Y. (Res., 42 Nutman Pl., West Orange, N.J.)

Gorman, William Campbell (M. '39), Res. Engr., Modjeski & Masters, 100 Crittenden St., Owensboro, Ky.

Guess, Samuel Cain (Jun. '39), Junior Engr, (Civ.), Mississippi River Comm., Box 80, Vicksburg, Miss.

Hastilovich, John (Jun. '39), Asst. Eng. Aide, Bureau of Constr. and Repair, Navy Dept. (Res., 618 Quebec Pl., N.W.), Washington, D.C.

Hatchett, Joseph Morton (M. '39), City Engr., City Hall, Petersburg, Va.

Houston, Albert J. R. (M. '39), Engineer, Harza Engineering Company; President, Midland Constructors, Inc., 205 West Wacker Drive, Chicago, Ill.

Jones, James Allen (Jun. '39), City Engr., Box 547, Cleveland, Miss.

Koch, Sidney (Jun. '38), 128 Catalpa Ave., Perth Amboy, N.J.

Lewis, Charles Frederick (M. '39), Mgr. and Chf. Engr., Volunteer Portland Cement Co. (Res., 3033 Fountain Park Boulevard), Knoxville, Tenn.

Macdonald, Alexander Stuart (M. '39), Vice-Pres. and Gen. Supt., Strong & Macdonald, Inc., 1011 East F St., Tacoma, Wash.

McDougall, Leslie (Assoc. M. '39), Traffic Mgr., Highway Planning Survey, State Highway Dept. (Res., 802 North 10th Ave.), Phoenix, Ariz.

Madigan, Michael John (M. '39), Cons. Engr., (Madigan-Hyland), 20 Exchange Pl., New York, N.Y.

Meyer, Harry (Assoc. M. '39), Capt., Corps of Engrs., U.S.A., Asst. to Dist. Engr., U. S. Engr. Office, Box 97, Memphis, Tenn.

Moeller, Henry George (Jun. '39), Care, Harza Eng. Co., 205 West Wacker Drive, Chicago, Ill.

Monarchi, Joseph (Jun. '38), With Ohio Div. of Conservation, State Office Bldg., Columbus, Ohio.

Morris, Max Hyman (Jun. '38), Topographical Draftsman, Grade 3, Dept. of Boro Works of Manhattan, Municipal Bldg. (Res., 892 Fairmount Pl.), New York, N.Y.

Nichols, Don Lee (Jun. '39), 1431 Pioneer Hall, Univ. of Minnesota, Minneapolis, Minn.

Oakland, Godfrey Lyon (Assoc. M. '39), Asst. Hydr. Engr., Water Resources Branch, U. S. Geological Survey, 526 Federal Bldg., Albany, N.Y.

Olsen, Frederick James (Jun. '39), With Premier Crystal Laboratories, 63 Park Row (Res., 140 West 105th St.), New York, N.Y.

Pettibone, Gilbert William (Assoc. M. '39), Constr. Engr., State of California, Box 86, Copperopolis, Calif.

Purdy, Frank Hart (Assoc. M. '39), Asst. Topographic Engr., U. S. Geological Survey, Box 346, Sacramento, Calif.

Reading, Oliver Scott (M. '39), Hydrographic and Geodetic Engr., U. S. Coast and Geodetic Survey (Res., 5107 Thirty-Eighth St., N.W.), Washington, D.C.

Reid, Lincoln (Assoc. M. '39), Instr., Civ. Eng., School of Technology, Coll. of the City of New York, 139th and Convent Ave. (Res., 150 Claremont Ave.), New York, N.Y.

Sanford, Jasper Hetler (M. '39), Civ. and Structural Engr. (Sanford & Phillips), (Res., 124 East Monroe St.), Colorado Springs, Colo.

Scott, John Kuhn (Assoc. M. '39), Insurance Solicitor, The Fidelity and Casualty Co. of New York, 801 Arrott Bldg. (Res., 923 North Highland Ave., E.E.), Pittsburgh, Pa.

Shamamian, Vincent (Jun. '39), Junior Hydr. Engr., U. S. Geological Survey, Water Resources Branch, Care, Board of Water Supply, New York City, Ellenville, N.Y.

Shappert, Frederick William, Jr. (Assoc. M. '39), Pres., Shappert Eng. Co., 112 West Pleasant St., Belvidere, Ill.

Sholl, Louis Pesler (Assoc. M. '39), Asst. County Engr., Nueces County (Res., 634 Atlantic St.), Corpus Christi, Tex.

Shone, Douglas John (Jun. '39), St. Helier, Jersey, Channel Islands.

Smith, Austin Bettis (Assoc. M. '39), Asst. Engr., Mississippi River Comm., Vicksburg, Miss.

Stiles, Ed Miles (Jun. '39), Box 264, Tupelo, Miss.

Stolk, Juan Francisco (Assoc. M. '39), Director, Hydr. and Sanitary Works, Ministry of Public Works, Apartado 964, Caracas, Venezuela.

Traczewski, Stanley Edward (Jun. '38), 115 Sussex St., Jersey City, N.J.

Van Camp, Roy K. (M. '38), Engr., PWA, 150 Hurt Bldg., Atlanta, Ga.; Res., 2216 Fifteenth Ave., Bradenton, Fla.

Vannort, Bertram Orlando (M. '39), Engr., Asheboro, N.C.

Weber, Harold Edward (Jun. '38), Draftsman, Fitzpatrick Lumber Co., 900 South 9th St. (Res., 1311 South Pasfield), Springfield, Ill.

Wehner, Stephen (M. '39), Hydr. Engr., Public Utility Eng. & Service Corporation, Chicago (Res., 202 Elmore Ave., Park Ridge), Ill.

Weir, William Victor (M. '39), Supt. and Chf. Engr., St. Louis County Water Co., 6600 Delmar Ave., St. Louis, Mo.

Wheeler, David Houston (Assoc. M. '39), Plant Engr., Calaveras Cement Co., Box 24, San Andreas, Calif.

Wilson, Claude Sessler (Jun. '39), Structural Engr., Fort Smith Structural Steel Co., 600 South Wheeler, Fort Smith, Ark.

Woodward, Charles Henry (Assoc. M. '39), Asst. Civ. Engr., City Engr's. Office, 1580 Vinewood Ave., Detroit, Mich.

Woolf, Abraham (Assoc. M. '39), 549 Oakwood Ave., West Hartford, Conn.

Youngs, Walter Charles, Jr. (Assoc. M. '39), Laboratory Research Engr., Materials and Tests Div., State Highway Dept. (Res., 1605 Waterston Ave.), Austin, Tex.

MEMBERSHIP TRANSFERS

Allin, Ray Lester (Jun. '14; Assoc. M. '19; M. '39), Hydr. Engr., Hetch Hetchy Project, Bureau of Eng., Public Utilities Comm. (Res., 70 Northwood Drive), San Francisco, Calif.

Argetsinger, John Deem (Jun. '30; Assoc. M. '39), Asst. Dist. Engr., WPA, Fritsche Bldg., New Ulm, Minn.

Beach, George Oliver (Jun. '34; Assoc. M. '39), Asst. Constr. Engr., W. A. Klinger, Inc., 201 Warnock Bldg. (Res., 1308 Grandview Boulevard), Sioux City, Iowa.

Bray, Dwight Hubert (Assoc. M. '31; M. '39), Director of Maintenance, State Highway Dept., (Res., 218 Steele St.), Frankfort, Ky.

Brown, Francis Leo (Jun. '32; Assoc. M. '39), County Supt. of Highways, Washington County, Box 128, Hudson Falls, N.Y.

Cadilla Ginorio, Ulises (Jun. '35; Assoc. M. '38), Civ. Engr., Puerto Rico Reconstruction Administration, Box 372, Arecibo, Puerto Rico.

Cannell, Paul John (Assoc. M. '36; M. '39), Designer, Central Nebraska Public Power and Irrig. Dist., Tri-County Office (Res., 918 West 11th St.), Hastings, Nebr.

Carrier, Virgil Sampson (Jun. '30; Assoc. M. '39), Archts. Supt., State Highway Dept. (Res., 116 Hill Ave.), Elgin, Ill.

Downing, Claire Ansel (Assoc. M. '36; M. '39), Engr. in chg., Municipal Testing Laboratory, City of St. Louis, 55 Municipal Courts Bldg., (Res., 5372 Cabanne Ave.), St. Louis, Mo.

Gardner, Thomas Herbert (Assoc. M. '30; M. '39), Structural Engr., Florida East Coast Ry. (Res., 71 Carrera St.), St. Augustine, Fla.

Hanson, Loring Outhier (Jun. '28; Assoc. M. '39), Farm Specialist, Wisconsin, Portland Cement Assoc., 1813 Vilas Ave., Madison, Wis.

TOTAL MEMBERSHIP AS OF JUNE 9, 1939

Members	5,654
Associate Members	6,402
Corporate Members	12,056
Honorary Members	27
Juniors	3,952
Affiliates	74
Fellows	1
Total	16,110

HIGGS, GEORGE WASHINGTON, JR. (Jun. '32; Assoc. M. '39), Constr. Engr., Public Buildings Branch, Procurement Div., U. S. Treasury Dept., Washington, D.C. (Res., 10 Melrose Ave., Hyattsville, Md.)

JEWELL, ROBERT BURNETT (Jun. '28; Assoc. M. '39), Asst. Engr., Port of New York Authority, 522 Gregory Ave., Weehawken, N.J. (Res., 189-02 Thirty-Fifth Ave., Flushing, N.Y.)

KEEFER, THOMAS SMYTH, JR. (Jun. '37; Assoc. M. '39), Care, E. H. Keefer & Son, 1321 Rodman St., Philadelphia, Pa.

LEBARON, ROLLA PARKER (Jun. '28; Assoc. M. '39), Estimator and Welding Engr., Midwest Steel & Iron Works Co., 25 Larimer St. (Res., 1426 South Vine St.), Denver, Colo.

LINDEMAN, MALCOLM DANIEL (Jun. '29; Assoc. M. '39), Civ. Engr., Charles E. DeLeuw & Co. (Res., 7627 South Ridgeland Ave.), Chicago, Ill.

MARTIN, ROBERT OLOF ROLAND (Jun. '31; Assoc. M. '39), Asst. Hydr. Engr., Water Resources Branch, U. S. Geological Survey, 526 Federal Bldg., Albany, N.Y.

MEYER, CARL FREDERICK (Jun. '23; Assoc. M. '28; M. '39), Prof., Civ. Eng., Worcester Polytechnic Inst., Worcester, Mass.

OGRAM, ARTHUR VAUGHN (Jun. '28; Assoc. M. '39), Junior Engr. (Civ.), U. S. Engrs., U. S. Engr. Office, Jacksonville, Fla.

QUARTLY, ERIC VERNON ASHTON (Jun. '34; Assoc. M. '39), Deputy Area Engr., WPA, Broadway Pier Bldg., San Diego, Calif.

RINEY, ARTHUR HERBERT (Assoc. M. '18; M. '39), Vice-Pres., Phillips Petroleum Co., Bartlesville, Okla.

ROBERTS, MARVIN EDWARD (Jun. '27; Assoc. M. '39), Project Engr., SCS, U. S. Dept. of Agriculture, 2406 Capers Ave., Nashville, Tenn.

RYDEEN, JAMES PHILIP (Jun. '30; Assoc. M. '38), Asst. Topographic Engr., U. S. Geological Survey, Washington, D.C.

SHANE, HENRY KAMSLER (Assoc. M. '32; M. '39), Hydrology Subsection Head, Gen. Eng. Section, Kansas City Dist., War Dept. (Res., 3214 Bellefontaine), Kansas City, Mo.

SMEED, HAROLD FRANKLIN (Assoc. M. '27; M. '39), Director of Operations, WPA of New York State, Old Post Office Bldg. (Res., 97 Melrose Ave.), Albany, N.Y.

STARR, WILLIAM LAWRENCE (Jun. '36; Assoc. M. '39), Office Engr., Dist. 11, State Highway Dept., Lufkin, Tex.

URE JAMES EDWIN (Jun. '28; Assoc. M. '39), Eng. Insp., Board of Water Supply, City of New York, Katonah (Res., Bedford Ridge, Mount Kisco), N.Y.

WEST, ARTHUR LOWELL (Jun. '26; Assoc. M. '39), 56 Westminster Drive, Atlanta, Ga.

WILLIER, GEORGE JOSEPH (Jun. '30; Assoc. M. '39), Engr., Federal Power Comm., Washington, D.C. (Res., 430 Poplar St., Springfield, Mo.)

WOODBRIDGE, CYRIL JAMES (Jun. '30; Assoc. M. '38), Res. Engr., State Div. of Highways, 806 California State Bldg. (Res., 518 South Carondelet St.), Los Angeles, Calif.

REINSTATEMENTS

EBLING, EVERETT ERNEST, Assoc. M., reinstated May 29, 1939.

KILLIAN, JOSEPH ADOLF, M., reinstated May 29, 1939.

MACKINNON, JOHN HAROLD, Assoc. M., reinstated May 22, 1939.

MOORE, RUSSELL BERNARD, Assoc. M., reinstated May 25, 1939.

NUDENBERG, NATHANIEL JOHN, Jun., reinstated May 26, 1939.

PARKER, ANTOINE PANET, Jun., reinstated June 2, 1939.

SCHEDER, WILLIAM SYLVESTER, Assoc. M., reinstated May 16, 1939.

SMALL, HERBERT WESLEY, JR., M., reinstated May 11, 1939.

TUTAN, GEORGE WASHINGTON, Assoc. M., reinstated May 16, 1939.

RESIGNATIONS

BOSCHKE, GUY, Assoc. M., resigned May 9, 1939.

DRISKO, JOHN BUCKNAM, Jun., resigned May 1, 1939.

WATERBURY, CLARENCE LESLIE, Jun., resigned June 9, 1939.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

July 1, 1939 NUMBER 7

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

FOR MEMBER

BRADNER, JAMES WOOD, JR. (Assoc. M.), Norris, Tenn. (Age 38) (Claims RCA 0.3 RCM 10.2) July 1937 to date Mgr. of Norris Properties, TVA; previously Town Mgr., Norris, Tenn.; Chf. of Eng. Sec., Land Planning and Housing Div., TVA, Knoxville, Tenn.

BRENNAN, MARTIN HOGAN, Cleveland, Ohio. (Age 40) (Claims RCM 9.5) 1926 to date with Great Lakes Dredge & Dock Co. as Field Engr. for Contr., Asst. Div. Engr., and (since 1929) Div. Engr., Cleveland Div. (Alpena, Mich. to Conneaut, Ohio), on marine contracts.

BRUNS, THOMAS NELSON CARTER (Assoc. M.), New York City. (Age 37) (Claims RCA 5.2 RCM 6.6) July 1937 to date with Raymond Concrete Pile Co., visiting and managing jobs from New York office, and (since Nov. 1938) in charge of operations at Newport, R.I.; Oct. 1928 to July 1937 with Doullut & Ewin, Inc., Gen. Contrs., New Orleans, La. as Asst. Supt. and Supt., etc.

CUMMING, SAMUEL JAMES, Tuscaloosa, Ala. (Age 56) (Claims RCA 3.8 RCM 29.4) Oct. 1932 to date with Alabama State Highway Dept. as Res. Engr., and (since Nov. 1933) Div. Engr.

DECKER, ARTHUR JAMES (Assoc. M.), Ann Arbor, Mich. (Age 58) (Claims RCA 2.4 RCM 25.7) Sept. 1909 to date with Univ. of Michigan as Instructor in, Asst. Prof., and Associate Prof. of Civ. Eng., 1 year Associate Prof. in charge of Dept. of Eng. Mechanics, 19 years Prof. of San. Eng., and at present Prof. of Civ. Eng.; 1913 to 1938 also in private practice.

DOUGHERTY, EDWARD JAMES (Assoc. M.), Baltimore, Md. (Age 49) (Claims RCA 6.3 RCM 21.0) Nov. 1915 to date with H. S. Kerbaugh, Inc., Empire Eng. Co., Inc., The Geo. W. Rogers Constr. Corporation and The Empire Constr. Co., acting as Supt. Gen. Supt. and Pres.

GOSNELL, EDWARD LESLIE, Baltimore, Md. (Age 51) (Claims RCA 2.3 RCM 26.3) Sept. 1906 to Aug. 1914 and Feb. 1916 to date with Baltimore & Ohio R.R. as Chainman, Rodman, Transitman, Res. Engr., Asst. Engr., Office Engr., Asst. to Chf. Engr., and (since July 1930) Prin. Asst. Engr.

HAVELY, HENRY BENTON, Chattanooga, Tenn. (Age 50) (Claims RC 8.9 D 4.9) Sept. 1935 to date Engr. Inspector, PWA, at present on electric power distribution system; previously Dist. Supervisor, Malaria Control, TVA and CWA.

INGLIS, CLAUDE CAVENDISH, Poona, India. (Age 56) (Claims RCA 6.4 RCM 24.6) Oct. 1906 to date with Secy. of State for India, Indian Dept. of Public Works as Asst. Engr., Executive Engr. Superintending Engr., and (since April 1937) Director, Central Irrigation and Hydro-Dynamic Research, Poona for all of India.

KELLY, PAUL AUGUSTINE (Assoc. M.) Yonkers, N.Y. (Age 45) (Claims RCA 9.5 RCM 8.8) July 1935 to date Senior Engr., PWA; at present Chf. of Squad in charge of several Federal Aid projects under construction; previously Asst. Engr., Gibbs & Hill, Cons. Engrs. Pennsylvania R.R.

MCCOMAS, JAMES ROLAND, Baltimore, Md. (Age 42) (Claims RCM 6.2) Nov. 1919 to date with Bureau of San. Eng., Maryland State Dept. of Health, reviewing engineering reports and contract plans and specifications for sanitary projects, etc.; 1932 to date also with Water Resources Comm. of Maryland.

MCCUTCHEN, ROY MARSH, Pittsburgh, Pa. (Age 44) (Claims RC 10.4 D 2.2) Oct. 1917 to date with U. S. Army as 2d Lieut., 1st Lieut., and Capt., acting as Supply Officer, Commander of Company, Asst. to Div. Engr., and (since Aug. 1935) Asst. to Dist. Engr. acting as Executive Officer, Chf. of Constr., Head of Eng. Div.

Mallen, Edward John, Davenport, Iowa. (Age 50) (Claims RCA 9.7 RCM 8.0) March 1930 to date with U. S. Engr. Office as Asst. Engr., Associate Engr., acting as Res. Engr., and (since July 1935) Res. Engr., in charge of construction of Lock and Dam No. 14 Mississippi River at LeClaire, Iowa.

Mann, John Herbert Claiborne (Assoc. M.) Lexington, Va. (Age 38) (Claims RCA 1.0 RCM 10.3) Sept. 1921 to Sept. 1925 and Sept. 1926 to date at Virginia Military Inst. as Instructor, and (since Sept. 1927) Asst. Prof. of Civ. Eng.

Maxson, Thomas Emerson, Memphis, Tenn. (Age 38) (Claims RCA 3.6 RCM 6.0) Nov. 1929 to date Chf. Draftsman and Office Engr., Dept. of Public Works, having responsible charge of drafting, estimates, design, plans and reports, concrete bridges, and culverts.

Niles, Thomas McMaster, Kenmore, N.Y. (Age 37) (Claims RC 11.8 D 8.0) July 1925 to date Asst. Engr., Greeley & Hansen, Chicago.

Orr, Nolan Bristow, Indianapolis, Ind. (Age 36) (Claims RCA 2.7 RCM 4.6) June 1923 to March 1924 and March 1926 to date with Indiana State Highway Comm. as Designer, Detailer, Checker, Senior Engr., and (since Nov. 1934) Superv. Engr.

Peterson, Earl Lloyd, Buffalo, N.Y. (Age 58) (Claims RC 26.5 D 15.8) Feb. 1934 to date Superv. Engr. and Project Engr., PWA, Washington, D.C., inspecting and directing compliance with plans and specifications, studying and approving contract documents, plans and specifications, etc.

Shahani, Chetanram Mangharam, Calcutta, India. (Age 35) (Claims RC 5.0 D 4.5) Dec. 1927 to date with Braithwaite & Co., Engrs. (India), Ltd. as Apprentice Engr., and (since Dec. 1930) Asst. Engr.

Sloan, Charles Elonzo (Assoc. M.), Baltimore, Md. (Age 54) (Claims RCA 4.6 RCM 16.3) Jan. 1913 to date with Baltimore and Ohio R. R. Co., Bridge Dept. as Draftsman, Chf. Bridge Draftsman, and (since March 1923) Asst. Engr. of Bridges.

Sutton, William Godfrey (Assoc. M.), Johannesburg, South Africa. (Age 45) (Claims RCA 4.0 RCM 17.1) Jan. 1926 to date Prof. of Civ. Eng., Univ. of Witwatersrand.

Tompkins, William Fraser, New Orleans La. (Age 46) (Claims RCM 19.8) Sept. 1916 to date with U. S. Army as 1st Lieut., Capt., Adjutant and Major of Engrs., and at present Lt.-Col., Corps of Engrs., acting as Asst. to Chf. of Supply Sec., Post Executive Officer, Asst. to Dist. Engr., and (since June 1936) Dist. Engr.

Tucker, Herman Franklin (Assoc. M.), Seattle, Wash. (Age 61) (Claims RC 13.2 D 20.7) Jan. 1936 to May 1937 and July 1938 to date Res. Engr. Inspector, PWA; Nov. 1912 to date (at intervals) Const. Structural Engr. on consultations, reports, bridge and structural designs, studies, expert testimony, etc.; Nov. to Dec. 1933 Design Engr., State Highway Dept., Seattle; previously Associate Eng., U. S. Eng. Dept., Seattle.

Walker, Stanton (Assoc. M.), Washington, D.C. (Age 45) (Claims RCA 3.0 RCM 16.7) Jan. 1926 to date Director, Eng. and Research Div., National Sand and Gravel Assoc.; also, since 1930 Director of Eng., National Ready Mixed Concrete Assoc., and since 1936 Cons. Engr., National Industrial Sand Assoc.

Wardlaw, Joseph George (Assoc. M.), Columbia, S.C. (Age 37) (Claims RCA 8.6 RCM 5.7) Aug. 1934 to Jan. 1936 Engr., and Jan. 1938 to date Asst. Chf. Engr., Buzzards Roost Hydro-Elec. Development, Greenwood, S.C.; in the interim Regional Engr. Inspector and Engr. Examiner with South Carolina State Director of PWA.

Williams, Charles Wyatt (Assoc. M.), New York City. (Age 46) (Claims RCA 4.8 RCM 12.4) Jan. 1938 to date Asst. Commr., Borough Works, Manhattan, New York City; May 1936 to Jan. 1938 in private practice; previously Secy., Suburban Eng. Co.

Yingling, Clinton Kemp., Jr., Washington, D.C. (Age 42) (Claims RC 9.7 D 14.6) Aug. 1930 to date Associate Structural Engr. and Structural Engr., U. S. Treasury Dept., Procurement Div., Public Bldgs. Branch.

Young, Truman Paddack (Assoc. M.), Cincinnati, Ohio (Age 41) (Claims RCA 3.2 RCM 8.5) April 1935 to Aug. 1936 Structural Engr., and March 1938 to date Cons. Structural Engr., Cincinnati Highway Dept.; in the interim Engr., Ferro Concrete Constr. Co.; previously Supt. for J. R. Breeden, Contr.; in private practice promoting municipal projects.

FOR ASSOCIATE MEMBER

Amneus, Thomas Axel (Junior), Oakland, Calif. (Age 32) (Claims RCA 3.7 RCM 0.0) 1937 B.S. in Civ. Eng., Univ. of Calif.; Sept. 1937 to date Chf. of Field Party, City of Oakland.

Anderson, Edward Carew (Junior), Oakland, Calif. (Age 31) (Claims RCA 2.7 RCM 0.0) March 1939 to date with Henry J. Kaiser Co., estimating and preliminary design on gravel and cement-manufacturing plant; Jan. 1932 to March 1939 with various companies on plans, design, estimating, etc., for reinforced concrete, steel fabrication for hoisting equipment, for construction of copper-concentrating plant, etc.

Bonnett, Charles Alfred (Junior), Salem, Ore. (Age 32) (Claims RCA 2.8 RCM 0.0) June 1933 to date with Oregon State Highway Comm. as Stakeman, Chainman, Payroll Checker, Office Asst., Transitman, and (since Dec. 1937) Engr.'s Asst.

Bradlee, Warren Richard Greenwich, Conn. (Age 33) (Claims RCA 7.5 RCM 1.6) June 1928 to Nov. 1931 and Jan. 1934 to date with Metcalf & Eddy as Inspector, Asst. Engr., Supt., and Res. Engr., since Dec. 1937 on construction of sewage-treatment plant and out-fall; in the interim Asst. Supt. and Engr., and later Supt. with Lewis E. Moore, Engr., Boston Mass.; Supt. and Gen. Foreman with L. Luchini & Sons, Milford, Mass.

Croom, Thomas Green (Junior), Indianapolis, Ind. (Age 32) (Claims RCA 4.8 RCM 0.0) Sept. 1931 to Oct. 1932, Dec. 1933 to April 1935, Aug. 1936 to Oct. 1938 and at present with Indiana State Board of Health as Asst. Engr., Asst. State Director of Community Sanitation, etc., and (after Aug. 1936) Engr., Bureau of San. Eng.

Curtis, George Lewis (Junior), New York City. (Age 31) (Claims RCA 4.9 RCM 2.0) May 1935 to date Engr., Sheffield Farms Co., Inc.; previously Chainman, U. S. Coast and Geodetic Survey; Chf. of Party, CWA and ERA.

Cushman, Allerton Richardson (Junior), Boston, Mass. (Age 32) (Claims RCA 2.5 RCM 0.0) Oct. 1937 to date Asst. Engr., Hydraulic Dept. New England Power Service Co.; previously Jun. Engr. and Asst. Engr., Diversion Damages Dept., Metropolitan Dist. Water Supply Comm.

Flint, Lawrence Lowell, Des Moines, Iowa. (Age 41) (Claims RCA 4.7 RCM 11.2) May 1939 to date Managing Director, Prof. Div., Iowa Eng. Society; previously with Iowa State Highway Comm. as Pavement Inspector, Instrumentman, Inspector, and Div. Maintenance Engr.

Galatis Anthony Constantine, Athens, Greece. (Age 30) (Claims RCA 4.9 RCM 0.0) March 1938 to date Engr., Ministry of the Air, in control of projects for airports, buildings, shales, reinforced concrete design, steel structures, etc.; Jan. 1938 to date (spare time) Engr., Hellenic Hydro-electric Corporation, New York City, under representative in Athens; previously Engr., Ministry of Agriculture, Direction of Hydr. Works.

Givan, Charles Vernon, Davis, Calif. (Age 34) (Claims RC 7.0 D 3.0) Sept. 1926 to date with Univ. of California as Tech. Asst., Div. of Irrigation Investigations and Practice, Jun. Irrigation Engr., Experiment Station, and (since July 1934) Asst. Irrigation Engr. also acting as Asst. Prof.

Hansen, Ralph, Little Rock, Ark. (Age 42) (Claims RC 5.1 D 5.8) May 1934 to date with U. S. Engr. Office as Inspector and Laboratory Asst., Soils Laboratory, Asst. Engr., and (since July 1937) Associate Engr.

Hazen, Richard (Junior), Dobbs Ferry, N.Y. (Age 27) (Claims RCA 2.0 RCM 0.0) July 1937 to date Asst. Engr. with Malcolm Pirnie, Civ. Engr.; Feb. to June 1939 also Associate in Civ. Eng., Columbia Univ.; previously Asst. Engr., Eng. Dept., West Virginia Pulp & Paper Co.

Henderson, Harold Rains (Junior), Marshall, Tex. (Age 32) (Claims RCA 2.9 RCM 4.3) Feb. 1935 to date County Engr., Harrison County, Tex.; previously Rodman, Concrete and Bridge Inspector, and Instrumentman acting as Project Engr., Texas State Highway Dept.

Hobbs, Merrill Hopkins, Washington, D.C. (Age 44) (Claims RCA 7.2 RCM 6.4) April 1929 to July 1930, May 1931 to Oct. 1933 and July 1936 to date Cons. Engr. (private practice); in the interim successively Associate Civ. Engr., War Dept., Design Branch; Structural Designer with E. C. Ruebsam, Cons. Engr.; Chf. Eng. Draftsman, U. S. Naval Academy.

Kievit, James Wesley (Junior), Toledo, Ohio. (Age 32) (Claims RCA 1.6 RCM 1.2) July 1936 to date Architectural Engr., Libbey Glass Co. (Owens-Illinois Glass Co.); previously structural Engr., H. P. Jones Co.; with Closure Service Co. (Owens-Illinois Glass Co.) Toledo, on field measurements and drafting for plant remodelling.

Levy, Tobias Edwin, Philadelphia, Pa. (Age 39) (Claims RCA 4.5 RCM 6.0) 1937 to date Designing Engr. for Max A. Bernhardt and other Architects, on structural frames of steel and reinforced buildings of various types; previously in private practice on structural steel design, sales, detail, and erection.

Lingle, Robert Thomas, West Palm Beach, Fla. (Age 39) (Claims RCA 11.5 RCM 2.0) Sept. 1925 to date with Lake Worth Drainage Dist. as Transitman, Asst. Chf. Engr., Field Supt. and (since May 1939) Chf. Engr.

McDonald, Charles Casto (Junior), Albany, N.Y. (Age 31) (Claims RCA 4.2 RCM 0.0) March 1930 to March 1935 Jun. Hydr. Engr. and April 1935 to date Asst. Hydr. Engr., Water Resources Branch, U. S. Geological Survey.

Madden, Edward Peuch (Junior), New Orleans, La. (Age 32) (Claims RCA 5.2 RCM 0.0) March 1939 to date Structural Steel Detailer, Bethlehem (Pa.) Steel Co.; previously Structural Steel Checker and Detailer, Petroleum Iron Works, Beaumont, Tex.; Constr. Engr., Jefferson Lake Oil Co., Brazoria, Tex.; Chf. of Party, RA, Little Rock, Ark.; Surveyor, Gilbert & Kelly, New Orleans, La.

Marr, George Johnathon (Junior), Berkeley, Calif. (Age 32) (Claims RCA 4.3 RCM 0.5) July 1938 to date Jun. Engr., East Bay Municipal Utility Dist.; previously Field Engr. (under Project Supt.), J. H. Pomeroy & Co., Inc.; Truck Trail Locator and Cost Engr., U. S. Forest Service.

Mason, Martin Alexander (Junior), Washington, D.C. (Age 32) (Claims RCA 6.7 RCM 2.6) April 1925 to date with National Bureau of Standards as Under Scientific Aid, Jun. Mech. Engr., and Asst. Hydr. Engr.; Aug. 1937 to Nov. 1938 also Freeman Scholar in Hydraulics, Univ. of Grenoble, France.

Moffatt, John Gray (Junior), West Linn, Ore. (Age 32) (Claims RCA 7.7 RCM 0.0) March 1929 to date with Truscon Steel Co. as Detailer, Estimator, Dist. Engr., and (since Feb. 1937) Sales Engr., in charge of sales work in Washington, Idaho and western Montana.

Mohr, William Henry (Junior), Santa Monica, Calif. (Age 32) (Claims RCA 3.7 RCM 0.0) Sept. 1935 to March 1936 and July 1936 to date with California Div. of Highways as Res. Inspector, Asst. Res. Engr., and (since Feb. 1938) Jun. Highway Engr.; in the interim 1st Lieut., Engr. Reserves, U. S. Army, Fort Belvoir, Va.; previously Jun. Bridge Engr., Asst. Concrete Technologist, and Concrete Technologist, San Francisco-Oakland Bay Bridge.

Moore, Bernard Allen (Junior), Chicago, Ill. (Age 32) (Claims RCA 4.0 RCM 0.0) June 1935 to date Bridge Designer, Atchison, Topeka & Santa Fe Ry. Co.; previously Research Asst., Iowa Eng. Experiment Station; Structural Detailer, American Bridge Co.

Nettleton, Francis Joseph, Topeka, Kans. (Age 44) (Claims RC 16.3 D 2.3) Jan. 1926 to date with Highway Planning Dept., Kansas State Highway Comm. as Res. Engr., Div. Survey Chf., etc., and (since June 1938) Asst. State Mgr.

Nunn, Edward Hamilton, Catonsville, Md. (Age 44) (Claims RCA 9.8 RCM 0.0) May 1920 to date with Maryland State Roads Comm. as Inspector on highway and bridge construction, Dist. Engr., and (since Aug. 1935) Constr. Engr. in responsible charge of highway and bridge construction over entire state.

Odom, James Julius, Birmingham, Ala. (Age 34) (Claims RCA 4.0 RCM 0.0) June 1927 to date with Alabama State Highway Dept. as Levelman, Instrumentman, Div. Chf. Draftsman, Jun. Res. Engr., Res. Engr., and (since March 1939) Div. Materials Engr., 2d Div.

Ortiz, Jose Pulido, Pasadena, Calif. (Age 32) (Claims RC 1.9) 1937 and 1939 to date graduate student; 1935 to 1936 and 1938 Asst. Engr. on investigation and study of irrigation projects, and Engr. on construction of dry docks for Mexican Navy; 1936 Mexican Delegate to 3d World Power Conference and 2d Congress on large dams, Washington.

Pietz, Wesley Charles, Pittsburgh, Pa. (Age 34) (Claims RC 10.9 D 2.4) April 1927 to date with Raymond Concrete Pile Co. as Asst. Supt., Supt., Asst. to Office Mgr. of Constr., Asst., Asst. to Dist Mgrs., Chicago and Pittsburgh Offices, and (since March 1937) Dist. Mgr., Pittsburgh Office, handling tri-state area.

Scott, Silas Steele (Junior), Eupora, Miss. (Age 32) (Claims RCA 1.3 RCM 0.0) Nov. 1934 to date with Mississippi State Highway Dept., in drafting room, Squad Leader, in charge of field location party and on Natchez Trace survey; and right-of-way.

Shinick, George Sydney, Brooklyn, N.Y. (Age 32) (Claims RC 6.7 D 1.5) Sept. 1936 to date Topographical Draftsman, New York City Tunnel Authority; previously Structural Draftsman, Madigan-Hyland, Cons. Engrs.; Asst. Engr., Dept. of Parks, New York City; Field and Office Engr., Chas. E. Shinick, Co., Inc.

Simpson, Charles Francis, Tampa, Fla. (Age 44) (Claims RC 19.5) June 1937 to date Sales Engr., Florida Portland Cement Co.; previously Gen. Mgr., Gerald Smith Constr. Co., Road Contrs., Memphis, Tenn.; Laborer; Field Engr., Dist Engr., and Asst. to Regional Mgr., Portland Cement Association, Chicago.

Sitzler, John Boger, Peoria, Ill. (Age 31) (Claims RCA 4.8 RCM 0.0) June 1937 to date Prin. Asst. Engr., Eng. Dept., Peoria Dept. of Public Works, administrating Eng. Div.; previously Highway Engr., Highway and Railway Products Div., Wheeling (W.Va.) Corrugating Co.; with Illinois Div. of Highways as Jun. Testing Engr., and Asst. Dist. Engr. of Materials.

Stafford, Francis William, Akron, Ohio (Age 34) (Claims RC 7.0 D 4.8) 1935 to date Engr.-in-Chg., Ohio Dept. of Public Works, on work for Nimisila Reservoir Project; 1932 to 1935 Engr. in private practice.

Switzer, Jacob Wade (Junior), Chicago, Ill. (Age 32) (Claims RCA 3.3 RCM 0.0) July 1928 to March 1930 and May 1936 to date with Chicago Bridge & Iron Co., on general work, and (since May 1936) planning and supervising fabrication and shop assembly of steel-plate structures, etc.; Jan. to May 1936 Asst. County Engr., Decatur County, Iowa; March 1934 to Oct. 1935 Res. Work Relief Engr., Iowa ERA.

Tate, Guy Morris, Jr., Birmingham, Ala. (Age 29) (Claims RC 7.9 D 2.0) Nov. 1938 to date Director, Bureau of San. Eng., Jefferson County Health Dept.; previously Associate San. Engr., TVA.

Thomas, Francis (Junior), Leonia, N.J. (Age 33) (Claims RCA 8.2 RCM 0.0) Dec. 1936 to date Structural Steel and Concrete Designer, American Gas & Elec. Service Corporation, New York City; previously Erection Engr. with C. E. Halback, Brooklyn, N.Y.; Jun. Engr. U. S. Engr. Dept., Elmira, N.Y., and Denison, Tex.; Party Chf. and Topographer, Park Dept., New York City.

Thompson, Paul Williams (Junior), Vicksburg, Miss. (Age 32) (Claims RCA 1.2 RCM 4.2) June 1932 to Sept. 1933 Military Asst. to Director, and Feb. 1937 to date Director, U. S. Waterways Experiment Station; Sept. 1933 to Oct. 1935 Mil. Asst. to Dist. Engr., Omaha Engr. Dist.; Oct. 1935 to Feb. 1937 Freeman Scholar of Am. Soc. C.E.

Voronzoff, Paul Ileech, Silver Spring, Md. (Age 54) (Claims RCA 22.0 RCM 0.0) July 1938 to date with Procurement Div., U. S. Treasury Dept., Washington, D.C.; previously with Gibbs & Hill, Edison Co., and on WPA work for U. S. Navy.

Wagoner William Ray, Akron, Ohio (Age 39) (Claims RCA 7.9 RCM 0.0) Dec. 1938 to date San. Engr., Summit County Gen. Health Dist., acting as Consultant and Advisor cooperating with State Dept. of Health; previously Asst. Engr., Div. of Sewerage, Akron; Asst. Engr., Ohio State Dept. of Highways.

Weir, Leander Milton, Sacramento, Calif. (Age 31) (Claims RCA 2.8 RCM 0.0) Dec. 1928 to date with California Dept. of Public Works, until Feb. 1939 with Div. of Highways as Jun. Eng. Draftsman, Asst. Civ. Eng. Draftsman, Senior Eng. Office Aid and Jun. Highway Engr., and since April 1939 with Div. of Water Resources as Senior Eng. Aid.

Zeigler, Robert Ritchie, New York City (Age 28) (Claims RCA2.6 RCM 12.0) Oct. 1933 to date with Frederick Snare Corporation as Asst. Engr., Res. Engr., Field Engr. and (since Sept. 1938) Engr.

FOR JUNIOR

Allen, O. C., Albany, Tex. (Age 24) 1939 B.S. in Civ. Eng., Agri. & Mech. Coll. of Tex.

Allen, Robert Thomas, Chicago, Ill. (Age 25) 1939 B.S. in Civ. Eng., Iowa State Coll.; at present Technician, Portland Cement Association, Soil-Cement Laboratory.

Auping, William Bradford, Cleveland, Ohio (Age 24) 1939 B.S. in C.E., Univ. of Ky.

Baird, Robert Emmett, Houston, Tex. (Age 23) 1939 B.S. in Arch. Eng., Agri. & Mech. Coll. of Tex.

Balser, Leroy Adolph, College Station, Tex. (Age 22) 1939 B.S. in Civ. Eng., Agri. & Mech. Coll. of Tex.

Baskin, Benjamin, Detroit, Mich. (Age 23) 1939 B.S. in Civ. and Min. Eng., Mich. Coll. of Min. & Tech.

Beggs, Charles Alexander, Pensacola, Fla. (Age 28) 1939 B.S.C.E., Univ. of Fla.

Binnings, Clem Burke, New Orleans, La. (Age 20) 1939 B.C.E., Tulane Univ.

Blaha, Kenneth Albert, Cleveland, Ohio (Age 21) 1939 B.S. in Civ. Eng., Case School of Applied Sci.

Blotcky, Donald Eugene, Kansas City, Mo. (Age 20) 1939 B.S. in Civ. Eng., Univ. of Mo.

Brasher, Herbert, Lubbock, Tex. (Age 23) 1939 B.S. in Arch. Eng., Tex. Tech. Coll.

Breen, James Joseph, Jr., San Francisco, Calif. (Age 22) 1939 B.C.E., Univ. of Santa Clara.

Bugielski, Joseph Paul, Chicago, Ill. (Age 21) 1939 B.S. in Civ. Eng., Armour Inst. Tech.

Carlson, Carl August, East Cleveland, Ohio (Age 23) 1939 B.S. in Civ. Eng., Case School of Applied Sci.

Carlson, Ernest Carl, Chicago, Ill. (Age 21) 1939 B.S. in Civ. Eng., Armour Inst. Tech.

Chamberlain, Glenn John, Atascadero, Calif. (Age 29) (Claims RC 1.8 D 1.3) Oct. 1933 to date with California Div. of Highways as Jun. Laboratory Aid, Materials and Research Dept., and (since April 1936) Jun. Bridge Engr., Bridge Dept.

Chase, Paul Hiram, West Branch, Mich. (Age 23) 1939 B.S. in Civ. Eng., Mich. Coll. of Min. & Tech.

Cobb, William Lafayette, Lubbock, Tex. (Age 21) 1939 B.S. in Civ. Eng., Tex. Tech. Coll.

Collier, Thomas, Chicago, Ill. (Age 25) 1939 B.S. in Civ. Eng., Armour Inst. Tech.

Comrie, Russell Malcolm, Fargo, N.Dak. (Age 23) 1939 B.S. in C.E., N. Dak. State Agri. Coll.

Cowles, Charles Moodey, Painesville, Ohio (Age 23) 1939 B.S. in Civ. Eng., Case School of Applied Sci.

Dixon, Durwood Burtrum, Albuquerque, N. Mex. (Age 29) 1939 B.S. in Civ. Eng., Univ. of N.Mex.

Donald, William LaValle, Newhebron, Miss. (Age 27) 1939 B.S. in Civ. Eng., Miss. State Coll.

Egelhoff, Robert Melville, Newton Highlands, Mass. (Age 23) 1938 A.B., Dartmouth Coll. 1939 C.E., Thayer School of Civ. Eng.

Eustis, Joseph Bres, Vicksburg, Miss. (Age 26) (Claims RC 1.0 D 1.0) June 1934 to date with U. S. Waterways Experiment Station successively as Laborer, Laboratory Technician, Project Engr. and Asst. to Head of Soil Mechanics Laboratory.

Flynn, William Thomas, Jr., St. Louis, Mo. (Age 22) 1939 B.S. in Civ. Eng., Washington Univ.

Gomez, Manuel, Miami, Fla. (Age 23) 1939 B.S.C.E., Univ. of Fla.

Green, Kenneth David, Footscray W 11, Victoria, Australia (Age 21) 1937 B.C.E., Univ. of Melbourne; March 1939 to date Asst. Engr., River Gauging Sec., Rivers and Reclamation Div., State Rivers and Water Supply Comm.; March 1938 to March 1939 Senior Demonstrator in Civ. Eng., Univ. of Melbourne.

Green, Lloyd Frank, Lakewood, Ohio (Age 21) 1939 B.S. in Civ. Eng., Case School of Applied Sci.

Guiza, Donato Enrique, New Orleans, La. (Age 25) 1939 B.C.E., Tulane Univ.

Habans, Robert Nagle, New Orleans, La. (Age 22) 1939 B.C.E., Tulane Univ.

Harrell, Guy Buchanan, Jr., Yazoo City, Miss. (Age 20) 1939 B.S. in Civ. Eng., Miss. State Coll.

Hemphill, Otto Lertin, Chaffee, Mo. (Age 28) 1932 B.S.C.E., Univ. of Ark. 1938 B.S. in Agri. Eng., Iowa State Coll.; Nov. 1932 to date (intermittently) with Arkansas State Highway Comm., Little Rock, Ark.

Hirst, John Minot, Concord, N.H. (Age 21) 1938 A.B., Dartmouth Coll. 1939 C.E., Thayer School of Civ. Eng.

Hitchcock Charles Young, Jr., Boston, Mass. (Age 22) 1938 A.B., Dartmouth Coll. 1939 C.E., Thayer School of Civ. Eng.

Hopkins, Matthew Henry, Atlanta, Ga. (Age 26) (Claims D 3.5) 1934 B.S. in C.E., Ga. School of Tech.; March 1935 to date with W. C. Caye & Co. as Draftsman and later in charge of fabricating reinforcing steel bars, design of reinforced structures, etc.

Huddleston, Paul McKisson, Sanford, Fla. (Age 24) 1939 B.S.C.E., Univ. of Fla.

Jackson, Burt Allen, Cleveland, Ohio (Age 23) 1939 B.S. in Civ. Eng., Case School of Applied Sci.

Jacobson, John, Alburquerque, N.Mex. (Age 25) 1939 B.S. in Elec. Eng., Univ. of N.Mex.

Jeffries, James Curtis, Jr., Helena, Ark. (Age 22) 1939 B.S. in Civ. Eng., Miss. State Coll.

Johnson, Ernest Marlin, Buttzville, N.Dak. (Age 24) 1939 B.S. in C.E., N. Dak. State Agri. Coll.

Jones, Allen, III, Knoxville, Tenn. (Age 22) 1938 B.S. in Civ. Eng., The Citadel; at present Teaching Fellow, Univ. of Tennessee, acting as Instructor in elementary surveying (lecture and field).

Keller, Samuel Harris, Glendale, Calif. (Age 23) 1938 B.S., Calif. Inst. Tech.

Kelley, Howard Leslie, Agency, Mo. (Ag 23) 1939 B.S. in Civ. Eng., Univ. of Mo.

Kent, Roscoe Jack, New York City (Age 24) July 1937 to date with City of New York on summer scholarship, and since Sept. 1937 Topographical Draftsman, Dept. of Sanitation, and Dept. of Borough Works, Manhattan.

Kilgore, Clarence Boyd, Goose Creek, Tex. (Age 20) 1939 B.S. in Civ. Eng., Rice Inst.

King, Edward, Reno, Nev. (Age 28) 1939 B.S., Univ. of Nev.

Kirz, Benjamin, Chicago, Ill. (Age 21) 1939 B.S. in Civ. Eng., Armour Inst. Tech.

Koch, Alva Ernst, New Braunfels, Tex. (Age 21) 1939 B.S. in Civ. Eng., Agri. & Mech. Coll. of Tex.

Koval, Albert Stephen, Birmingham, Ala. (Age 25) (Claims RC 1.0) 1937 B.S. in Civ. Eng. Ga. School Tech.; Aug. 1937 to April 1938 with Ingalls Iron Works Co., Inc., Eng. Dept.; May 1938 to date Res. Engr., Steel Constr. Co., Mississippi River Bridge contract, Baton Rouge, La.

Larson, Harold Arthur, Fargo, N.Dak. (Age 24) 1939 B.S. in C.E., N. Dak. State Agri. Coll.

Laughlin, Edward Galt, Jr. Yazoo City, Miss. (Age 23) 1939 B.S. in Civ. Eng., Miss. State Coll.

Leseman, William Joseph, Jr., Green Cove Springs, Fla. (Age 22) 1939 B.S.C.E., Univ. of Fla.

Lieberman, Joseph Abraham, Baltimore, Md. (Age 20) 1938 B. of Eng., The Johns Hopkins Univ.

Littlefield, Joseph Nord, Elko, Nev. (Age 23) 1939 B.S. in C.E., Univ. of Nev.; at present with County Surveyor, Elko County.

Livingston, John Hall, Rolla, Mo. (Age 26) 1939 B.S. in Civ. Eng., Mo. School of Mines & Met.

Lynam, Thomas William, Wilmington, Del. (Age 23) 1939 B.S., Univ. of Del.

McCall, Robert George, Charleston, W.Va. (Age 25) (Claims RC 3.0 D 0.3) March 1938 to date Asst. San. Engr., State Health Dept.; March 1936–March 1938 San. Engr., Brooke County Health Dept.; previously Chainman and Draftsman, West Virginia State Road Comm.

McCullough, Lane Allen, Columbia, Mo. (Age 27) 1939 B.S. in Civ. Eng., Univ. of Mo.

McIntosh, David Milton, Gulfport, Miss. (Age 21) 1939 B.S. in Civ. Eng., Miss. State Coll.

McRoy, Wallace James, Meridian, Miss. (Age 24) 1939 B.S. in Civ. Eng., Miss. State Coll.

Manson, John Farnsworth, New Orleans, La. (Age 20) 1939 B.C.E., Tulane Univ.

Mansur, Charles Isaiah, Richmond, Mo. (Age 20) 1939 B.S. in Civ. Eng., Univ. of Mo.

Mason, Robert Wilbur, Western Springs, Ill. (Age 22) 1939 B.S., Mich. Coll. of Min. & Tech.

Mast, Earl Leroy, East Liverpool, Ohio. (Age 24) A.B., Wittenberg Coll. 1939 B.S. in Civ. Eng., Case School of Applied Sci.

Mooney, Joseph Richard, New Orleans, La. (Age 22) 1938 B.E. in M.E., and 1939 B.C.E., Tulane Univ.

Neubauer, Fred William, Chicago, Ill. (Age 21) 1939 B.S. in Civ. Eng., Armour Inst. Tech.

Noles, John Roy, College Station, Tex. (Age 20) 1939 B.S. in Civ. Eng., Agri. & Mech. Coll. of Tex.

Noragon, James Swisher, Buffalo, N.Y. (Age 21) 1939 B.S. in Civ. Eng., Case School of Applied Sci.

Norcross, William Ellis, Dorchester, Mass. (Age 23) 1938 A.B., Dartmouth Coll. 1939 C.E., Thayer School of Civ. Eng.

Olmstead, William Waldemar, Hempstead, N.Y. (Age 22) 1938 A.B., Dartmouth Coll., 1939 C.E., Thayer School of Civ. Eng.

Olson, Elmer H., Chicago, Ill. (Age 22) 1939 B.S. in Civ. Eng., Armour Inst. Tech.